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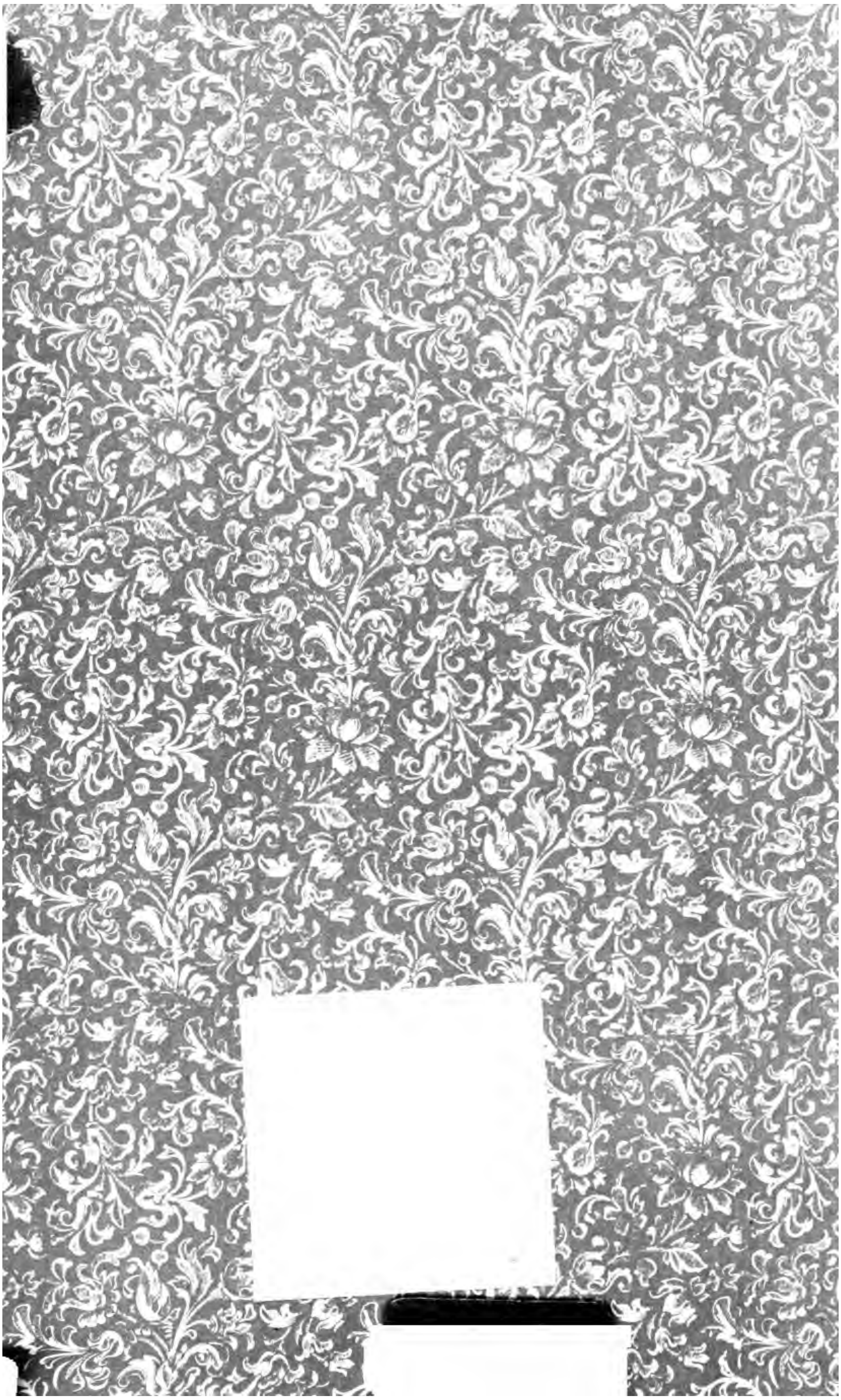

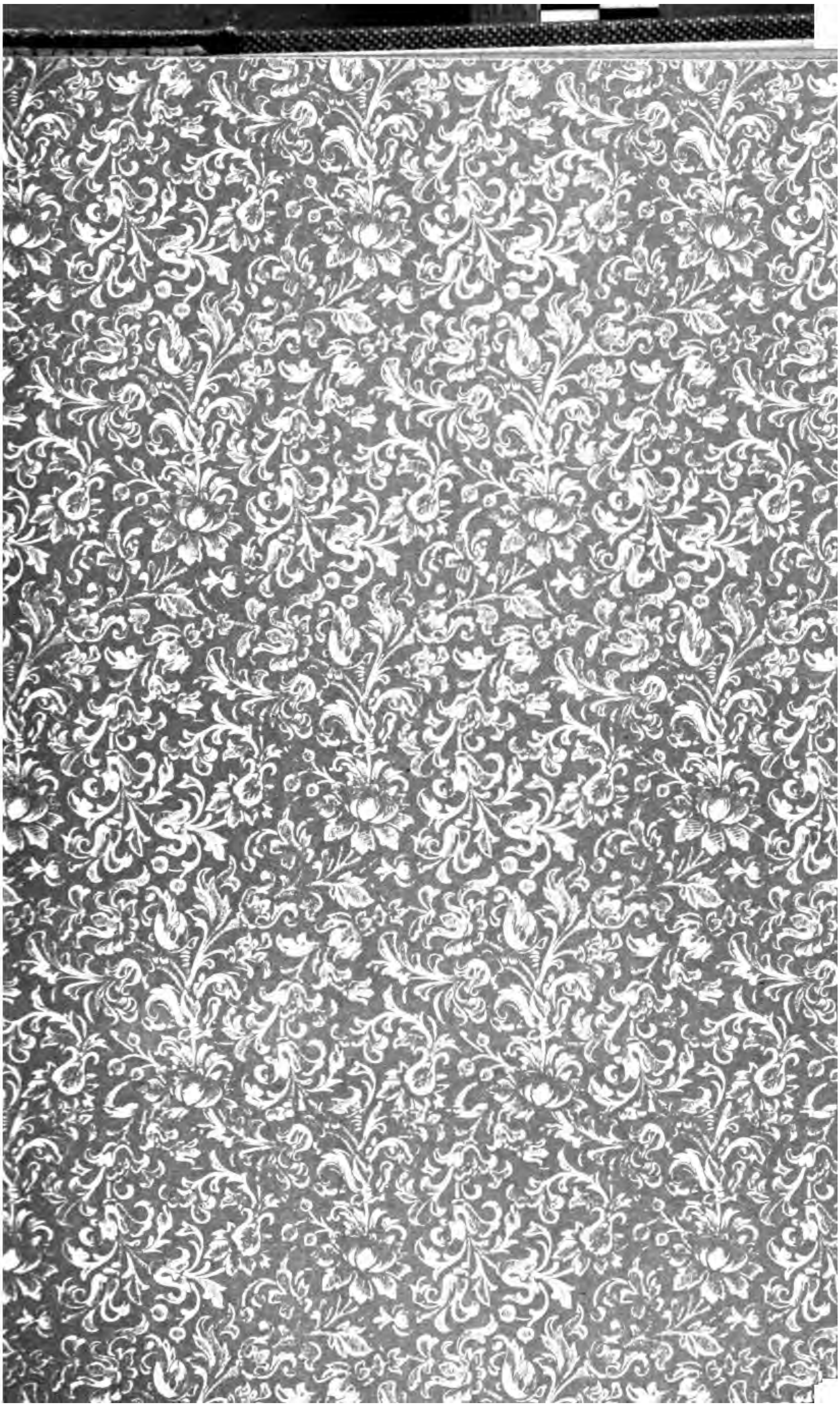

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GEOLOGICAL SURVEY OF CANADA
ALFRED R. C. SELWYN, C.M.G., LL.D., F.R.S., DIRECTOR

# ANNUAL REPORT

(NEW SERIES)

## VOLUME V

PART II

REPORTS P, Q, R, S, SS

1890-91

OTTAWA
PRINTED BY S. E. DAWSON, PRINTER TO THE QUEEN'S MOST
EXCELLENT MAJESTY
1893

PRICE OF VOLUME IN TWO PARTS, $2.00

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## ERRATA.

Page 19 R, side note, line 3, *omit* "Con."
Page 31 R, side note, line 2, *read* "of" *instead of* "on."
Page 44 R, side note, line 2, *insert at end* "Con."
Page 141 S, line 9, *after* "where no allowance is made by the buyers" *insert* "for the copper."

GEOLOGICAL SURVEY OF CANADA
ALFRED R. C. SELWYN, C.M.G., LL.D., F.R.S., DIRECTOR

# REPORT

ON

# GEOLOGICAL SURVEYS AND EXPLORATIONS

IN THE

# COUNTIES OF PICTOU AND COLCHESTER, NOVA SCOTIA

BY HUGH FLETCHER, B.A.

OTTAWA:
PRINTED BY S. E. DAWSON, PRINTER TO THE QUEEN'S
MOST EXCELLENT MAJESTY.
1892

To **Alfred R. C. Selwyn**, C.M.G., L.L.D., F.R.S.,
Deputy Head and Director of the Geological Survey of Canada.

Sir,—I have the honour to submit herewith a report on work done during the summers of 1887 to 1891 in the counties of Pictou, Colchester, Hants and Cumberland, as described in the Summary Reports of the department for these years.

**Map.** As in previous years, detailed surveys were made, plotted on a scale of forty chains to an inch and used with supplementary surveys obtained from the Admiralty, the Department of Railways and Canals, the Department of Crown Lands of Nova Scotia and Church's county maps, for the construction of a map on a scale of one mile to an inch on a projection laid down by Mr. Scott Barlow, and, west of Great Village River, mostly drawn by him from his own surveys.

**Assistants.** My assistants in different parts of the field work have been Messrs. M. H. McLeod, J. A. Robert, D. I. V. Eaton, A. Cameron, John McMillan, W. B. Almon, Fred. Coldwell and Prof. Coldwell; and in preparing the map, Messrs. Robert, Eaton and B. A. L. Huntsman.

To enumerate all those from whom we have received kindness, hospitality, assistance and information would be impossible, but the following gentlemen may be especially mentioned: Henry S. Poole, John Rutherford, J. G. Rutherford and Robert Drummond, of Stellarton; William B. Moore, W. P. McNeil, Jeffrey McColl, H. V. Jennison, Harvey Graham and James F. McLean, of New Glasgow; R. P. Fraser, James Hudson and Robert Simpson, of Pictou; Alex. McBean and T. M. Turnbull, of the Vale; A. McG. Barton, of Pine Tree; James Maxwell, John William Sutherland, James Fraser (Moose), Wm. Maddin and Charles Fergie, of Westville; John A. McKenzie of Lower Caribou River; James Wm. Hogg, of Pictou Island; R. E. Chambers, John Dunbar and Henry McLean, of Hopewell; Donald Fraser of Springville; John A. Cameron, of Bridgeville; Graham Fraser, of Trenton; A. McKimmie and A. Bain, of Riversdale; James Pitblado and J. K. Blair, of Truro; Gilbert Sutherland, of the Falls, Waugh River; John McKay (Ross), Robert Murray and Duncan McKenzie, of Earltown; Timothy McLennan and Dr. E. Roach, of Tatamagouche; Peter McIntosh and Hugh McKay, of

New Annan; G. W. Densmore, of Brookfield; Dr. W. D. McKenzie, Dr. A. S. Townshend, C. E. Day and W. F. Jones, of Parrsboro'; A H. McKay, James H. Austen, E. Gilpin, Martin Murphy, W. A. Hendry, A. F. Church, T. J. Ritchie, Charles J. McDonald and F. W. W. Doane, of Halifax; R. G. Leckie, W. F. Jennison and Wm. Smaill, of Londonderry Mines; P. S. Archibald and Wm. B. McKenzie, of Moncton; R. G. E. Leckie, of Middleton; Professor H. Y. Hind, of Windsor; Sir J. W. Dawson, of Montreal.

I have the honour to be, sir,
Your obedient servant,
HUGH FLETCHER.

# REPORT

ON

# GEOLOGICAL SURVEYS AND EXPLORATIONS

IN THE

# COUNTIES OF PICTOU AND COLCHESTER, NOVA SCOTIA.

## INTRODUCTION.

District described. The geology of that part of Nova Scotia which lies in the counties of Pictou and Colchester, west of the district to which Report P for 1886 relates is described in this report. Rivers. It embraces the basins of the rivers of Pictou and Caribou, Toney River, River John, Waugh and French Rivers, which flow into Northumberland Strait; Salmon, North, Stewiacke and Shubenacadie (in part) which flow into the head of Cobequid Bay; Chiganoïs, Debert, Folly, Great Village, Portapique, Economy, Five Islands, Moose, Parrsboro' and other rivers that empty into Minas Basin. Railways. The northern portion of this district is made accessible by the Oxford and Pictou branch of the Intercolonial railway, the southern portions by the main lines of this railway. The district is all well settled, with the exception of two tracts of mountainous country. Mountains. The first of these forms the Cobequid Hills which extend from Cape Chignecto to Mount Thom in a belt about ten miles wide which crosses the Intercolonial railway between Greenville and Folly Mountain. In places these hills rise to a height of 1,050 feet above the sea, being probably more than 400 feet lower than the highest summits of northern Cape Breton. The second tract of uninhabited country, from the Pictou branch of the Intercolonial railway between Valley and Glengarry stations south as far as the Stewiacke River settlements is an extension of that between East River of Pictou and the West River of St. Mary's.

Character of the soil. The district displays great variety of surface features accompanied by differences in the structure and constitution of its rocks. On Cobequid Bay and Minas Basin there are about 20,000 acres of rich meadowland reclaimed by dykes from the high tides of the Bay of Fundy. Along the rivers and brooks there are large belts of excellent intervale; while the upland, even to the summits of the hills, is fertile.

**Harbours.** On the north side is the excellent harbour of Pictou and the smaller harbours of Caribou, River John, Brulé and Tatamagouche, Boat and Little Harbours. Besides the Caribou Islands and several smaller islands near the mainland, Pictou Island, which is about five miles long and a mile wide, lies nine miles from Pictou light. The land along the shores is generally low, but views of great beauty are presented in several places, whilst the hills "exhibit prospects which in richness and variety of sea and land, hill and dale, river and shore, field and forest will compare with any in America."* Lakes add "in some places a pleasing variety to the landscape" and on some of the streams are beautiful cascades and pools.

**Scenery**

## GEOLOGY.

**Geological formations.** The geological formations found in this district are for the most part the same as, and an extension of, those described in the Report P for 1886, above mentioned. Of the large areas of Pre-Carboniferous metamorphic rocks by far the greater part consists of Devonian strata. The Cambro-Silurian is confined to the hills east and north of the valley of the East River of Pictou and between Sunnybrae and Plymouth at the south-eastern corner of the Pictou coalfield where the Silurian also occupies small areas and is not met with again except in limited patches at and near Earltown and in Waugh River. Devonian fossiliferous rocks are largely developed south of the East River of Pictou and thence without interruption run far to the westward of Truro on the south side of Cobequid Bay and Minas Basin. They appear again in Waters Hill, McCulloch's Brook and Mount Thom, and form, with the series of igneous rocks which are everywhere found to cut and alter them, the axis of the Cobequid Hills. They include the iron ore series of Londonderry and are similar to the metamorphic rocks of Antigonish and Guysboro' counties.

**Metamorphic rocks.**

**Carboniferous rocks.** Carboniferous limestone occupies a considerable portion of the basin of Stewiacke and Shubenacadie Rivers. Outliers are also found on Minas Basin, on Penny's Mountain, on the East Mountain of Onslow, resting in small unconformable patches on the Devonian rocks, also underlying the coal measures and millstone grit of the Pictou coalfield. The coal measures occupy an irregular area between the Middle River of Pictou and Sutherland River. A considerable area of Carboniferous rock skirts the south side of the Cobequid Hills; by Dr. Ells it is supposed to be Lower Carboniferous, while Mr. Barlow considers it millstone grit, and Sir William Dawson, coal measures.

---

*Patterson's History of the county of Pictou, Dawson Bros., 1877.

Permian.

Triassic.

Igneous rocks.

Along the northern part of Pictou and Colchester counties, from Big Island, Merigomish, to Brulé and Tatamagouche, there is a wide belt of Permian rocks, the conglomerate at the base forming Fraser's Mountain, Green Hill, Roger's Hill, Fitzpatrick's Mountain, Dalhousie Mountain, the Biorachin and other highlands on its course. The conglomerate is overlaid by grey sandstones, like those of Pictou and West River, containing one or more thin coal seams; and these are succeeded in turn by brownish and red sandstones and marls with thin layers of limestone. Dark red, crumbly, Triassic sandstone and conglomerate, generally in nearly horizontal attitude, occupy a basin which extends westward from near Valley station, one rim fringing the south side of Minas Basin, the other reaching much further inland on the north side. Two principal intrusions of igneous rock have been determined within the area. In one red syenite, diorite, felsite and similar rocks cut no strata newer than the Devonian, in the other Triassic sandstones are intersected and intermixed with great masses of basalt and amygdaloid which furnish the celebrated trap minerals of the Bay of Fundy.

Classification of rocks.

These strata may be classified as in the following tabular view :—

| | |
|---|---|
| M. Post-Tertiary. | |
| H. Triassic. | |
| G. 4. Permian | 1—Upper red sandstone and shale group, with thin bands of limestone.<br>2—Middle grey sandstone and shale group, with small coal seams.<br>3—New Glasgow conglomerate. |
| G. Carboniferous | G. 3—Coal measures.<br>G. 2—Millstone grit.<br>G. 1—Carboniferous limestone.<br>G. 1m—Carboniferous conglomerate. |
| F. Devonian | Upper red slate and sandstone group. Red rocks of Union, on the Truro and Pictou railway.<br>Middle grey slate and sandstone group. Riversdale and McKay Head rocks. |
| E. Silurian | E. 6—Lower Helderberg.<br>E. 3—Niagara.<br>E. 2—Clinton.<br>E. 1—Medina. |
| D. Cambro-Silurian | Upper sandstone and conglomerate of Bear's Brook.<br>Middle shale and sandstone of Baxter's Brook.<br>Lower flinty shale and sandstone of James River and Eigg Mountain. |

Igneous Rocks....... { Of Triassic or Post-Triassic age.
Of Devonian age.
Of Cambro-Silurian age.

## D.—CAMBRO-SILURIAN.

Constant association of the Cambro-Silurian with igneous rocks.

That within the areas marked Cambro-Silurian on the map there may be rocks of Silurian age, and that the boundaries in some cases may be vague, or that greatly altered patches of Silurian may have been mistaken for Cambro-Silurian is quite possible; but there is apparently a distinct series of these lower rocks, often so closely associated with Silurian strata and also with igneous rocks that it is difficult to determine whether they may not be Silurian indurated along the line of contact with igneous intrusions. They belong chiefly to the lower subdivisions especially to the Baxter Brook group. Most of the details regarding them were collected by Mr. Robert.

Park's mills and falls.

Contacts of Silurian and Cambro-Silurian, McLellan's Brook.

Bridgeville.

Iron ore.

The rocks of Park's Falls with associated masses of diorite, have already been described. At twenty paces above the bridge on the most westerly of the two brooks above the mill-dam, they are succeeded by Medina, quite unaltered, which are well exposed higher up the brook. South of the St. Mary's road hereabout are greenish and reddish, rubbly, flinty slates, like those of Baxter Brook, with red flinty grits and siliceous sandstones, succeed the coal measures or Carboniferous limestone, in some of the brooks and include a great variety of trappean rocks. In McLellan's Brook, at and below the falls, one mile below Brookville, trap and diorite, are followed down stream by slightly altered greenish-grey fossiliferous rocks, succeeded, further down stream, by greatly altered grits and bright greenish and reddish slaty argillites, probably Cambro-Silurian. The dip gives no key to the relation of the two series. In the brook which flows from the mountain church into McLellan's Brook, Silurian rocks are succeeded by greenish argillite and fine sandstone, having a much more flinty aspect, splintery, ringing and rubbly, veined with quartz. At the mountain church and on the road towards Brookville are light green, white-weathering, quartz-veined slates, almost certainly of this age. At the foot of the hill, however, and on the road towards Bridgeville, past James Seivright's they are succeeded, as elsewhere stated, by the Silurian; but further south white-weathering, scaly or schistose, fine, granular, felsitic rocks reappear, the Silurian lying, however, not far to the westward. In Mr. Thomas McMillan's fields, white quartzite is largely exposed with reddish grit and green slate. The quartzite contains veins of limonite and is in contact with greenish felsite and other igneous rocks. The road thence towards East River shows only Silurian. The other rocks of the neighbourhood of Mount Horeb are whitish sandstone, light greenish-grey, soapy, ribbanded slates, cut by diorite, and underlying Medina. At the head of the west branch of Sam Cameron's brook, underlying Clinton slates, are matted or felted, cleaved, greenish slates, but most of the rocks are volcanic.

**Mount Horeb.**

At Blue Mountain church is a purplish grit; green grit and slate are under the post office, while north of the school is a green flinty slate. Near McLellan's Mountain church are outcrops of greenish, fine, rubbly sandstone and slate, perhaps belonging to the Baxter Brook series; they underlie the Carboniferous limestone and are cut by greenish and dark grey diorite. Below the bridge, half a mile below the cemetery on McLellan's Brook, greenish, thick-bedded argillaceous sandstone, probably Medina, is succeeded by greenish calcareous rocks underlaid by red, massive, soft argillite, breaking into irregular pieces. The lowest green beds are nodular or brecciated, and sometimes splintery, associated with greenish, massive, flinty, fine sandstone and with layers of the peculiar breccia of Hartshorn Brook and Barney's River. A little lower down are outcrops of reddish grit, succeeded again by greenish, well-bedded argillaceous sandstone, sometimes brecciated and nodular, crowded with Silurian fossils; below this, the reddish and greenish rubbly rocks and reddish flinty, coarse grit with quartz veins and blotches, extending to the contact of the Carboniferous. Near McPherson's mill, green, somewhat soft, soapy slate contains yellowish-grey flinty bands. On the road from the head of Cross Brook to Brookville, succeeding Silurian fossiliferous rocks which extend to the north of the brook is a mass of diorite and, close by, white soapy slates. South of the road, the rocks seem to be Silurian, but along it for some distance reddish, flinty grit is close on the left and a diorite hill beyond. The grit is netted with veins of quartz and associated with reddish, flinty, compact slate. In proceeding down McLellan's Brook towarks Brookville, the hill recedes on the left leaving the road in Silurian rock as far as the bridge. A little beyond it, however, are masses of Cambro-Silurian grit and conglomerate.

**McLellan's Brook.**
**Intimate mixture of Cambro-Silurian and Silurian.**

On the East River immediately opposite the mouth of Ogg Brook, the rocks in the road are greenish slates with red layers, probably of the Baxter Brook group, and this is, perhaps, also, the age of the red and green, papery, soft slates cut in mining the iron ore in the tunnel on the west side of William Grant's Brook and also at Fraser's (saddler), although possibly these may represent

**East River of Pictou.**

**Iron ore of Grant's Brook**

altered members of the Lower Helderberg. The ore taken out 60 years ago is said to have come from beneath this red slate. On the left bank of Grant's Brook, a short distance higher, dark grey Arisaig slates are well exposed for some distance. At the upper mine level on the hill, the west wall shows greenish, soft, Silurian rock dipping westward at a low angle, whereas the east wall is a compact, flinty, white quartzite like that of McMillan's and probably Cambro-Silurian. This would seem to indicate a tongue of Cambro-Silurian perhaps joined with that of McMillan's between which and the Silurian the ore has been filled into a fissure ; but small veins of limonite also cut the quartzite. A tunnel driven at a lower level into the hill struck a face of light-greenish, earthy, shelly, Silurian rock from which the ore turned sharply to the eastward probably along the contact with the Carboniferous.

Glencoe Brook. In Glencoe Brook, immediately above the school, reddish, flinty rocks, perhaps Cambro-Silurian are followed by cliffs of Silurian as far as the falls. One bed is a flinty, quartz-veined quartzite not unlike that of McMillan's and also like the rocks associated with red

Silurian rocks. hematite at Webster's. Not far above the falls, however, Cambro-Silurian rocks reappear, and it may be that for some distance the brook forms the boundary. The fossils collected from the fall by Mr. Robert and examined by Mr. Ami were Medina. Near the source of the brook, veins of ankerite are found in flinty, splintery, ribbanded slates, associated with reddish-grey and greenish, soft, soapy slates. Lower down are rocks which may be newer and represent those found in the East River above Sunnybrae bridge—greenish and reddish, mottled, flinty rocks with joints full of films and small veins of hematite. They are associated with mottled, micaceous, soapy argillite, followed up stream by rocks more closely resembling the typical Medina. In the gorge, blackish, flinty, pyritous, massive rocks and greenish-grey rusty sandstones holding [illegible] and brachiopods are succeeded by the rocks described above.

Blanchard Brook. In the west branch of Blanchard Brook near its head are outcrops of Cambro-Silurian [illegible] near the Silurian. Quartzites and slates, perhaps of [illegible] age, are found also on Irish Mountain, and at the head of [illegible] Brook [illegible] greenish compact slates are associated with [illegible].

## V.—SILURIAN.

Descriptions of Silurian rocks. Numerous and interesting [illegible] of the Silurian localities referred to in this report have been given by Dr. Honeyman and Sir

J. William Dawson in the Transactions of the Nova Scotia Institute of Science, the Canadian Naturalist and Acadian Geology. The subdivisions are those adopted in the report for 18·6. No continuous sections like those of Arisaig have been measured, the outcrops being, as a rule, too much disturbed, although many good exposures occur.

by Honeyman and Dawson.

### E. 1.—Medina.

Areas of Medina.

The best exposures of this group, nearly always associated with Clinton and higher strata, are found on McLellan's Mountain, in Sutherland River, Cameron Brook, Holmes Brook, on the St. Mary's road and at Springville* some of which have been already referred to.

In some of the brooks the alternations of Silurian and Cambro-Silurian are very numerous and the breadth of the various groups of Silurian is necessarily narrow.

French River.

Glencoe Brook to Murdock Lake.

In the basin of French River, near Blue Mountain and in the neighbourhood of McPherson's mills there are outcrops of Medina and Clinton rocks. In Glencoe Brook, as already remarked, many of the rocks hold Medina fossils. The whitish fine grit or quartzite, veined with quartz, is, perhaps, of this age and runs out to William Grant's. Other outcrops, some distance above the road in this brook, consist of light grey slate and rusty-weathering sandstone, holding brachiopods and cut by threads of spathic iron. The flinty grit is probably that found at Sunnybrae; it passes near the head of Holmes Brook, not far from the Corrimony road, occurs some distance north of the fork of the roads, is found between McPherson's grist mill and Murdoch Lake and runs towards Blanchard. From McPherson's mills, for some distance on the road towards Glencoe school, the rocks are fragmental felsites. Then, in a steep hill on the right there are exposures of flinty quartzite, like that of Grant's, but a short distance beyond and immediately opposite the first bridge on the brook flowing southward into Glencoe Brook are rocks evidently Silurian.

The greenish, rusty-weathering, earthy, micaceous shale and massive rock at the head of Campbell Brook and towards Mount Horeb consist of Medina and Clinton overlying the Cambro-Silurian. On the southern slope of Mount Horeb siliceous Medina rocks are succeeded by black Clinton shales.

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* Trans. N.S. Inst. Sc., vol. III., pp. 62, 69, 70, 108; vol. IV., p. 464; vol. V., pp. 67, 72, 202, 207, 209, 293.

Iron mines.

At the Blanchard iron mines good outcrops of Silurian slate are found at Ross's and McDonald's and again near Glencoe Brook, at a knoll of diorite containing specular iron, in the unsettled land between the iron mine and Blanchard road and on that towards Webster's. The iron mine at Webster's[*] occurs among greenish-grey, tough, siliceous rocks associated with a whitish quartzose grit, doubtfully Niagara or Medina, their relation to the neighbouring Clinton slates being obscure. The grit on the east side of the road is possibly Silurian rather than Cambro-Silurian as at first supposed; but at Archibald Fraser's, in the Wentworth Grant, on Sutherland's River[†] an ore bed forty feet thick seems again to separate the Silurian from the fragmental slates which lie to the north, and at Angus Fraser's the ore is in white quartzite, perhaps also Cambro-Silurian. Again near the little lake at Archie Fraser's greenish, fragmental slate is associated with the ore, which is apparently, therefore, inclosed in Medina rocks overturned. It has been supposed that all these outcrops of red hematite are connected, but this is very doubtful. Between the ore at Webster's and the road to the school at Blanchard road, Clinton slates are found, and still more abundantly in the road. Some of the Silurian rocks of Earltown are, perhaps, Medina, but as they are chiefly higher they will not here be described.

### E. 2.—Clinton.

Descriptions of the Clinton.

Rocks of this formation occur chiefly at Sutherland River, Blanchard, McLellan's Brook, Cross Brook, Cameron Brook, Simon Fraser's Mountain, on the St. Mary's road, and at Earltown.[‡] They resemble, lithologically, the rocks of this age already described at Arisaig, presenting dark and light coloured shales with characteristic fossils. Among the dark slates of the neighbourhood of Blue Mountain are crumbly beds, which have been uselessly prospected for coal.

Search for coal.

Cross Brook igneous rocks.

In Cross Brook[||] above the track between Churchville and Johnston's, greenish and dark grey slates of this age are well exposed with a very variable dip, although blocks of trap are in the brook, rolled from the hill to eastward. Higher up, the rocks are more altered and contain quartz veins. On the road to eastward towards Brookville from the head of the brook, greenish Silurian rock is in contact with large masses of diorite, beyond which are slates, probably Cambro-Silurian; and on the road eastward from Brookville the contact of the Silurian and Cambro-Silurian is again well seen.

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[*] Trans. N.S. Inst. Sc., vol. V., p. 201.

[†] Trans. N.S. Inst. Sc., vol. IV., p. 140.

[‡] Trans. N.S. Inst. Sc., vol. III., pp. 70, 108, 258, 393; vol. IV., p. 464; vol. V., pp. 64, 65, 205, 207; Acadian Geology, pp. 560, 568.

[||] Trans. N.S. Inst. Sc., vol. III., p. 66.

Webster's iron mine.

In the neighbourhood of Webster's iron mine, Clinton slates are apparently overlaid by greenish arenaceous rocks like the Niagara; and according to Sir J. W. Dawson it is in rocks overlying the Clinton that the iron ores occur.* The slates again appear on the road to the bridge on McLellan's Brook; and for a considerable distance below the mills at this bridge banks of dark bluish-grey, pearly, papery slates with harder lenticular bands carry quartz veins which have been mined. They extend nearly to the road at the cemetery, where they appear to be in contact with Cambro-Silurian, with the intervention of a band of Medina. The light grey, micaceous, earthy shales in the brook below Webster's and in other brooks of this neighbourhood, are perhaps also of this age.

Quartz veins prospected.

Sam Cameron's Brook.

Immediately above the bridge at St. Paul's church, Sam Cameron's Brook passes between cliffs of dark, crumbly, rusty-weathering slate, overlying rocks of igneous origin, probably Cambro-Silurian. They are cut by quartz veins, two inches thick and downward, show many fucoidal markings, ferruginous veins and nodules of compact grey limestone. In the little tributary from the eastward are twisted, micaceous, graphitic slates.

William Grant's Brook.

In William Grant's Brook, bluish-grey, rusty-weathering slates, shiny and graphitic, showing little variety, except that in places they hold thin pyritous bands or veins and yield graphitized markings of plants, perhaps fucoids. In Holmes Brook, near the Corrimony road, twisted black slates contain minute quartz veins and numerous graphitized markings of minute branching plants.

Earltown and Salmon River.

The Silurian rocks of Earltown and the head of Salmon River† may here be described, although many of them are undoubtedly higher. They are everywhere unconformably overlaid by Permian conglomerate. In the neighbourhood of East Earltown and Spiedel Hill they consist of grey, greenish and bluish-grey slates full of fossils. In Waugh River above Gilbert Sutherland's, the bluish-grey, flinty, splintery, compact quartzites, with threads of quartz and calcspar, first seen in irregular, nearly vertical bedding, are succeeded up stream by dark bluish-grey, more argillaceous, rusty-weathering rocks, greatly contorted, exposed nearly to the bridge on the road to Baillie's.

Igneous rocks.

The cliffs of the brook above the hotel at the village of Earltown show dioritic rock in contact with grey, rusty-weathering, fine massive slate, full of shells. In one of the brooks running into Waugh River, some miles below Earltown, are siliceous, greenish and bluish-grey, fossiliferous slates, with quartz veins and blotches. Fine ledges are also found on the road which runs north-west from the post road at Earltown mills of rusty-weathering, massive, grey, argillaceous and siliceous rocks, full of threads of quartz. On the road west from Earltown church, Silurian debris is abundant. At the old mill-dam near John McKay's (Ross) is an outcrop of bluish-grey flaggy argillite which makes good whetstones and is full of shells. Beyond it, however, are outcrops of flinty, red argillite sandstone and conglomerate succeeded by the Permian conglomerate of Matheson Brook. The relation of the red rocks to the Silurian is somewhat obscure. They may be above or below it, but have in the meantime been included in the Devonian. At the cross roads in the Biorachin are greenish, compact, quartzo-feldspathic sandstones and bluish-grey, rubbly, striped slates, perhaps Lower Helderberg, in contact with black diorite. Further west are dark slates full of fossils; and on the road from Earltown towards Kemptown are other outcrops. On that which runs west from the county line near William Ferguson's, bluish-grey flinty rock is seen near the Permian conglomerate of the neighbourhood, which is largely composed of its debris. In some places it contains shells which are clearly Silurian, in others it is brecciated, slaty and compact, evidently altered by the igneous rocks of the vicinity so that it might be mistaken for the rocks which have been called Cambro-Silurian at the East River of Pictou. Associated with the hard rocks and bluish-grey slates, are others probably higher, which contain fossils resembling Niagara and Lower Helderberg. Towards Nuttby certain outcrops were found, containing fossils which may perhaps point to the contact of the Silurian with the Devonian of that neighbourhood; but these require further examination.

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* Canadian Naturalist, vol. IX., No. 6.

† Dawson's Acadian Geol., p. 270; Supplement, pp. 75 and 76; Trans. N.S. Inst. Sc., vol. III., pp. 346 and 393.

Whetstones.

Contact with Permian.

Metamorphism by igneous rocks.

Wentworth.

The Silurian rocks of Wentworth and the vicinity on the north side of the Cobequid Hills have been fully described by Dr. Ells,* who refers also to a list of fossils determined by Mr. Ami from a part of the series. In the cuttings immediately west of the station, dark green, fine diabase cuts and alters rubbly Clinton slates. In the next cuttings the rocks resemble more closely the siliceous Medina, those first seen being cut by a mixture of dark diorite and reddish syenite or granular quartz-felsite. The sedimentary rocks here are very massive and, near the dykes, rubbly. At the tunnel on Whetstone Brook, between two cuttings, these siliceous

Igneous rocks.

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* Ann. Rep. Geol. Surv., vol. I., 1885, Part E, p. [illegible]; Cf. also Supplement to Acadian Geology, pp. [illegible] and [illegible]; Trans. N.S. Inst. Sci., vol. III., p. [illegible]; vol. IV., p. 478.

rocks are on the upper side, while at the mouth of the tunnel a mass of granular and fine dark diabase has to north of it a silicoous Medina rock, succeeded immediately by dark Clinton slates. Down stream and overlying come greenish flags, full of shells, probably Upper Clinton, which present a considerable thickness before they are interrupted by Permian? sandstone at the fork of a branch from the south-east. At the tunnel over the branch immediately west of Wentworth the brook shows large outcrops of dark, friable, altered slates. Up stream, dark diorite is succeeded immediately by siliceous Medina, finely exposed in cliffs near the head of the brook.

Fossils discovered by Mr. Barlow in River Philip.

Other small detached outcrops of sedimentary rocks occur among the igneous rocks of the mountains west of Wentworth, in the Second River, in Bulmer Brook and other streams. From dark shales in a little brook at the road near Farmington, discovered by Mr. Scott Barlow in 1876, were obtained the following fossils determined by Mr. Ami:—

PLANTÆ.

1. *Palæophycus sp.* or *Palæochorda* sp.

GRAPTOLITHIDÆ.

2. *Cyrtograptus Grayiæ*, Lapworth, or a very closely related species.

BRACHIOPODA.

3. *Lingula lamellata*, Hall (*Cf. Lingula striata*, Sowerby).
4. *Leptæna transversalis*, Dalman.
5. *Rhynchonella nucula?* Sowerby, or *R. cuneata*, Dalman.
6. *Leptocœlia hemispherica?* Sowerby, or allied species.

This is the first time that the genus *Cyrtograptus* has been recorded in America. It is eminently characteristic of the lower half of the Silurian system.

### E. 3. Niagara, and E. 6. Lower Helderberg.

Upper Silurian areas.

Rocks of these formations overlie the Clinton in most of the Silurian areas and are well exposed at Springville, in Sutherland River, Blanchard and other localities.* A list of these is given by Dr. Honeyman in the Transactions of the Nova Scotia Institute of Science, vol. III., p. 393; and a list of the fossils in vol. V., p. 210.

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* Trans. N.S. Inst. Sc., vol. III., pp. 8, 63, 66, 68, 71, 107, 393; vol. IV., p. 465; vol. V., pp. 200, 201, 202, 209, 223.

McLellan's Brook.

In McLellan's Brook, not far above the contact of the Carboniferous limestone, are outcrops of mottled, reddish and greenish Silurian rocks apparently of this age. Higher up in a little brook from the eastward and also in the main stream at a mill and fall, the diorite of the fall (against which the Silurian rocks come nearly or quite unaltered) extends for a little distance and is then succeeded by greenish, massive Silurian rock, rusty-weathering and perhaps Niagara; followed up stream by greenish-grey and bluish massive rocks, and bright red and green, calcareous, slaty, argillite and limestone, dipping steeply down stream and holding Lower Helderberg fossils. Higher still are reddish, grey and greenish flags, crowded with fossils. Immediately above the first clearing on this brook, however, these rocks are succeeded by Cambro-Silurian.

East River of Pictou.

The earthy, rusty-weathering, micaceous rocks in Campbell Brook east of William Grant's on the East River of Pictou, are perhaps Niagara. The ledges which appear in the fields north of David's Lake are said by Dr. Honeyman to be Lower Helderberg; and similar rocks occur on the hill between that lake and the road. East of the post road between Springville and Bridgeville are great blocks and outcrops of apparently horizontal strata also of this age. On the right bank of the East River of Pictou for some distance above Bridgeville the higher Silurian rocks are exposed. In Holmes Brook, earthy, micaceous flags, containing Niagara brachiopods, are overlaid by Carboniferous limestone, under which the brook runs to appear again at the Sluice. A short distance above the contact, fine bluish-grey rocks, spotted with ankerite, are crowded with *Avicula Honeymani;* and, higher still, are succeeded by grey and greenish sand-stones. On Irish Mountain, steel-grey, rusty sandstones and slates of Lower Helderberg age also occur.

Overlap of Carboniferous

McGregor's Mountain.

The Silurian strata of McGregor's or Weaver's Mountain* are in part at least Niagara and Lower Helderberg—reddish and greenish, calcareous, mottled, metamorphic slates and limestones, associated with blackish, graphitic beds, veined and blotched with calcspar and passing into limestones.

North Earltown.

The rocks that underlie the Permian conglomerate of North Earltown contain, among others, beds of fine calcareo-argillaceous sandstone, in one place nearly pure limestone, greatly resembling Niagara. The outcrops, however, are not extensive, the more common exposures in this district being of flinty reddish argillite and conglomerate, apparently Devonian.†

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* Geological Survey Report for 1866–69, p. 5.

† Acadian Geology, Supplement, 1878, p. 76.

## F.—DEVONIAN.

The metamorphic rocks of the mountains, chiefly Devonian.

As already stated, most of the metamorphic areas of the hills of Antigonish, Pictou and Colchester counties consist of rocks whose geological position is between the group containing marine fossils of Lower Helderberg age and the Carboniferous or Mountain limestone, also characterized by the occurrence of marine types, whereas all the fossils found in the intervening Devonian consist of shells indicative of a shallow-water origin and of plants both drifted and erect indicating land conditions. Between this series and those underlying and overlying there is everywhere the clearest evidence of enormous unconformity, and although from the abundance of their plant-remains they have sometimes been confounded with millstone grit and even higher strata* their relations to the Carboniferous limestone at the East Mountain of Onslow and Penny's Mountain, at Shubenacadie, Stewiacke, Walton, Cheverie, Parrsboro' and wherever the two series are in contact, and the ease with which they can be traced from point to point, shows that they are to be compared rather with the Mispeck and Little River groups of New Brunswick and that the Carboniferous limestone rests unconformably on the slates.

Plants.

Relation to Carboniferous

Comparison with New Brunswick.

Some particulars have already been given† regarding the character and thickness of these rocks on the line of the Intercolonial railway between Valley and Hopewell. A close examination of the country both north and south of the railway has since been made.

Intercolonial railway.

The conglomerate, or lowest of the three groups into which this series has been subdivided, is here absent. A broad belt of the upper or red slate series lies north of the railway between Glengarry and Riversdale, the boundary passing thence south nearly to the Stewiacke River and the rocks appearing on both sides of Minas Basin; while the grey slate series occupies a large area at the head of the Stewiacke; and areas of both are found in the Cobequid Hills, where they have been examined by Mr. Scott Barlow and Dr. Ells.‡ The iron ore of the Londonderry mines appears to occur in rocks identical with the reddish, green and rusty slates which in Antigonish, Guysboro' and Pictou counties contain such a large quantity of specular iron ore which is worked at several places§

Londonderry iron mines

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[*] Acadian Geol., p. 283, line 17, and p. 561; Supplement, 1878, p. 48; Fossil Plants of the Lower Carboniferous and Millstone Grit, 1873, pp. 9, 29, 33.

[†] An. Rept. Geol. Surv., vol. II., 1886, Part P, p. 64.

[‡] An. Rept. Geo. Surv., vol. I., 1885, Part E, pp. 48-51.

[§] An. Rept. Geol. Surv., vol. II., 1886, Part P, p. 49.

a horizon intermediate between the two groups. It will be best perhaps to include them with the upper group, as the red strata are characteristic. Like the Cambro-Silurian and Silurian these rocks, generally situated in the mountains, are so contorted that their relations to one another are not always easy to make out.

### F. 2.—Middle Devonian.

Character and distribution of the middle group.

This group is characterized by the occurrence of grey sandstone and slate, yielding fossil plants even when nearly in contact with syenite and diorite as so frequently happens. Its general characters have been described in the Report for 1886, Part P, p. 55. It is most largely developed south of the East River of Pictou and the Pictou branch of the Intercolonial railway as far as Riversdale, where it is succeeded by the red rocks. With regard to both this group and that succeeding, we are met by a difficulty in determining the minute geological structure in the absence of distinct layers and in the crumpled and faulted condition of their beds; but, as outcrops are generally abundant, a close examination will usually effect this.

Sunnybrae.

Near Black Taylor's Lake south of Sunnybrae are beds of steel-grey and greyish flinty grit and conglomerate or quartzite and slate. John Macdonald's (Ogg) Brook, above East River road and above a small branch from the west, is occupied by dark graphitic slates, cut by greenish, massive, felsitic, trappean and granitoid rocks and blotched with veins of quartz and ankerite. In the east branch are interstratifications of the Guysboro' quartzites and flags, including bands of flinty nut-conglomerate, the surrounding country being as usual barren or half barren. At several points small veins of limonite and red hematite have been found.

Igneous rocks.

Iron ores.

Maple Lake.

Near the head of the Black Brook of Centredale and on the wood roads to Maple Lake are light bluish-grey quartzite and slate. The track to the lake from James McKenzie's passes first over black slates, but nearer the lake the slates alternate with quartzites. Similar rocks occupy the upper part of Maple Brook, while above Sam Cameron's mill-dam are fine exposures of black twisted graphitic slate with harder siliceous slate and quartzite.

West Branch, East River of Pictou.

On the Trafalgar road near Donald Fraser's, black slates are in place, succeeded, near the road to Elgin, by flinty, Upper Devonian rocks, which are also well exposed in the river. But the West Branch below the lake presents only a few small narrow outcrops of dark slates, quartzites and massive flinty pyritous grits, the river being bouldery and hard to follow. From this formation the slates quarried in this district are obtained. Some of them are rippled; in the cliffs at the mill near Angus McIntosh's they hold plants. In the rocky barrens bordering West Branch Lake, Speid Lakes, Rood's Lake and other lakes of the vicinity are ledges of Devonian slate and quartzite.

**Cullen's iron mine.**

On the road from Lorne to the iron mine at Cullen's, occasional outcrops of black slate are met with succeeding the dark shales of the valley. In the Drug (Truagh) Brook, bluish-grey Devonian slates, rusty-weathering, graphitic and twisted, are well exposed and contain, at the old dam, veins of limonite. In Cross Brook, succeeding the softer rocks near the road, are blackish slates and light grey flinty quartzites, alternations of which are seen to the head of the brook. In the Big Brook these rocks begin immediately below Thomas McDonald's mill, and can be traced along the road from this mill towards Glengarry.

**Middle River of Pictou**

Above the railway bridge in Middle River are interstratified bluish-grey regularly bedded flags and slates. Below the fork of the two branches are greenish and grey, fine, ripple-marked, evenly bedded shales and sandstones, breaking into large rectangular blocks which may belong to this horizon, but are succeeded down stream by indian-red, soft, crumbly shales, containing patches of pea-green shale apparently of the upper group. On the roads from Glengarry and Lansdowne towards Stewiacke, black shales are interstratified with white-weathering quartzites as far as John Robert McKay's.

**Lansdowne and Glengarry to Stewiacke.**

The first rocks seen in the branch of Middle River which crosses the railway at the big embankment immediately west of Lansdowne are greatly altered slates, interstratified with more quartzose rocks, full of quartz veins. The exposure, however, is small and the other rocks of the neighbourhood look like those of Riversdale and less altered than those of the railway, while in texture and composition they are identical. The grey slates in the fields near the head of this branch of the river hold plants, and their resemblance to those of the railway is remarkable. The Rocky Brook at the head of Stewiacke River, which crosses the road about two miles from the station, falls over cliffs of considerable beauty, composed of more or less sandy slates, dark grey, micaceous, and like certain rocks of Landsburg's. On the whole dark slates predominate, as at Sunnybrae, Drug Brook and Mount Misery. Near the shore of Dryden Lake, however, a quantity of reddish slate debris perhaps indicates an outlier or extension of the upper series to this point. From the fork at the county line at McKay's, dark rocks extend nearly to the head of the settlement of Eastville.

On the old road which runs southward from Gordon Summit, flaggy sandstones, slaty, veined with quartz and interstratified with dark bluish micaceous slates, marked with carbonized plants, extend far towards Stewiacke.

West River, Pictou.

Above the railway, in the first little brook east of Baillie's Brook at West River station, are dark slates which are again exposed in the next brook near the shanty at the railway. On the road south from the station are blocks of greenish, flinty sandstone; above the bridge on the brook is a quartzite that cannot be distinguished from that of the Stewiacke road, and further out are black slates. In Baillie's Brook, above the railway, grey, fine, soft sandstone and coarse grit, easily split in the bedding, flaggy or thick bedded, perhaps represent the rocks which include the coal. It is possibly Carboniferous, but more probably a portion of the Devonian.

West of West River, the boundary between the red and grey rocks seems to cross the railway about Campbell's Siding and has been already described.* By Dr. Honeyman these rocks seem to be regarded as Clinton.† The grey flags of the barrens north of the railway are associated with quartz-veined quartzites. In the little brook south of the railway at Landsburg's are light grey flinty flags also veined with quartz, and on the blueberry barrens in the neighbourhood of Williamson's Meadow Brook, among low conical hills interspersed with large hay marshes and wet barrens covered with a scanty growth of bushes and a few poplars and spruces, the rocks are apparently also those of the railway.

Riversdale.

In the brook, one mile east of Riversdale, the dark slates, grey, micaceous, somewhat soft sandstones and light greenish-grey and grey, compact, flinty sandstone are veined with quartz containing specks of pyrite, which has, no doubt, led to the search made here for gold. East of this brook another, crossing this railway, shows up stream cliffs of light grey, rust-spotted, rusty-weathering, flinty quartzite. In the large brook opposite, which enters Black River from the north-west, grey and reddish, fine, flaggy sandstone and crumbly argillite, marked with fossil plants, either represent the rocks of Campbell's Siding or are possibly higher. The head of this brook comes near the Riversdale road, and near it another rises which crosses this road but shows no rocks.

Search for gold.

Fossils.

The flags and slates of the railway immediately east of Riversdale contain *Stigmaria* and the fossil plants collected by Messrs. Weston and Robert.‡ They do not in any respect resemble the

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* An. Rept. Geol. Surv., vol. II., 1886, Part P, p. 64; Trans. N.S. Inst. Sc., vol. II., part III., p. 169.

† Op. cit., vol. II., part I., p. 118; vol. III., p. 39.

‡ An. Rept. Geol. Surv., vol. II., 1886, Part P, p. 64.

Carboniferous, but rather, as already stated, the quartzite series of Guysboro'. Even the black shales are slaty and resemble the Pre-Carboniferous rocks of other localities. In Salmon River, above the confluence of Black River, dark shales are apparently overlaid by massive, grey, flinty quartzite or sandstone, and by broken flags.

**Calvary Brook.**

Although most of the rocks of Calvary Brook belong to the upper and intermediate groups, some of them are dark slates, alternating with whitish, flinty, Guysboro' quartzites indistinguishable from those of the railway cuttings. The dip being very changeable, the separation of the two groups requires the closest examination. The black slates contain nodules of ironstone and are veined with quartz and calcspar. The coarse grits include patches of conglomerate. A short distance above the railway bridge, limestone has been dug.

In Baillie's clearing, south of West River Station, and in other clearings nearer the station, dark slate is found, although blocks of grit occur near the brook. Further south, in Anderson's old clearing, are bluish-grey slate and white weathering, quartz-veined quartzite. In Calvary Brook, near the track from a hay meadow to this clearing, are outcrops of greenish-grey, rusty-weathering, fine, flinty sandstone or quartzite, interrupted down stream by a concealed interval, at the end of which are whitish-grey flinty sandstones or quartzites, with druses of quartz, sometimes in flags which break into brick-shaped pieces, interstratified with coherent, splintery argillite, breaking into knife-shaped splinters, sometimes 18 inches long. Alternations of flags and shales extend some distance down stream and are overlaid by a thick band of rusty-weathering, whitish, pyritous, Guysboro' quartzite, succeeded near the driving-dam by the red and green rocks.

**Fossil plants.**

Above the track in Calvary Brook outcrops are not numerous. They consist of grey, rusty-weathering, flinty shales and flags like those of the railway; of blackish graphitic shales and flags, showing markings of *Cordaites* and other fossil plants; and of whitish-grey sandstone with bright indian-red patches like that of Sutherland Brook on the East River of St. Mary's. Blocks of grey, flinty Devonian sandstone occur on the wood-roads running to West River and in the barrens and rocky woodland between these and the head of Stewiacke River, in all the headwaters of which light grey, slaty sandstone and shale, dark, blackish-grey, massive quartzite or flinty sandstone, micaceous, sometimes netted with veins of crystalline quartz, light and dark grey argillites, in part papery and graphitic and like the Devonian rocks of Sunnybrae, are equally abundant. There is, however, little variety. The more flinty rocks form barrens covered with pieces of stone broken like road metal. In the branch of Calvary Brook from the south, above the driving-dam, flaggy, rippled sandstone or quartzite is overlaid by grey, soft shales, while higher up are cliffs of whitish, brown-spotted quartzite like that of the barrens of Grand River and Guysboro'.

South of the track to Island Lake, the Pembroke road shows grey and reddish, flinty, glistening, red-spotted quartzite, associated with grey argillite or slate like that of the Big Brook of Stewiacke; flaggy sandstone, rubbly, flinty and micaceous, holding plants, and like that north of Riversdale.

Salmon River.

Black River below Riversdale exposes rocks which are again seen far up Salmon River. The first of these are greenish-grey argillite, somewhat crumbly shales and sandstone with ironstone, alternating with very flinty flags. Down stream are grey, rusty-weathering, flinty sandstones and a great thickness of black, polished, twisted slates, with a few hard, siliceous bands and intercalated lenticular layers of limestone, one of them eighteen inches thick. Greenish and dark grey, rusty-weathering argillite and sandstone, coarse and very flinty, breaking into irregular bricks, are next succeeded by black shale or slate, with flinty, flaggy bands and irregular layers of rusty limestone, overlaid, near the confluence of Salmon River, by red argillites of the higher series, with lighter reddish and whitish quartzite in great cliffs. Similar alternations occupy Salmon River for some distance above the fork, dipping down stream.

Stewiacke River.

These rocks are well exposed in many of the brooks flowing into Stewiacke River, but in most of them do not seem to require special mention, the outcrops being indicated on the map. In the Black Brook, from the crossing of the old Stewiacke road, they comprise dark bluish-grey flags and flinty slates, twisted and blotched with lenticular veins of quartz. The dip is always high, often vertical. In the upper part of the brook the slates predominate, while lower down there is a larger proportion of the coarse whitish quartzite of Guysboro'. Similar rocks are exposed to the head of the settlement near Eastville. In the river, about a mile above the first settler, a micaceous, quartz-veined, coarse sandstone or quartzite seen in high cliffs, probably represents the rocks of the Guysboro' barrens and of Speid Lake; is on the horizon of those of Rocky Mountain, and also perhaps of those of Salmon River near the fork of Black River. It shows large hematite-red blotches; certain beds are shaly or flaggy, but it is for the most part thick-bedded; it is full of broken carbonized plants and of impressions of *Cordaites*. Among the finer beds is a band of quartz-veined conglomerate with pebbles three inches in length. A short distance below the bridge a thin band of

Fossil plants.

dark bluish-grey shale is full of stipes and broken leaves of ferns and of *Psilophyton*. Down stream they are succeeded by the upper series.

**Salmon River.** In the cliffs and fine reefs of Salmon River below the red bridge on the road west of Riversdale, the rocks belong largely to this group, consisting of alternations of dark shales and flags like those of Riversdale. Higher up are blackish splintery shales and thick-bedded sandstones, with dirty greenish-grey argillite, including a band, at least 15 inches thick, of black, coaly, *Cordaite* shale, which perhaps represents the coal seam of Kemptown. **Coal.** Light grey, fine, flinty, micaceous sandstone, with small quartz veins, in one of which a speck of copper pyrites was found, dirty greenish-grey, rusty-weathering sandstone and shale, light grey, fine, flinty sandstone and dark bluish-grey shale are then found to the saw-mill, above which are dirty greenish-grey argillites and light grey sandstone full of carbonized plants. **Copper ore.** At the Telegraph road the rocks include red bands. Up stream they are not so well exposed, but grey, flinty, fine sandstones extend to Jacob Fenton's, resembling those of the south branch of North River. Dark bluish-grey shale and flinty sandstone occupy the road from Kemptown to the red bridge, the road from this bridge to Riversdale and all the other roads in the vicinity.

**McKenzie Brook.** McKenzie Brook, which flows into Salmon River above Valley, exposes, not far above Philip Archibald's house, greenish-grey shales, grey, somewhat flinty, quartzose sandstone, and sandy flags covered with markings of *Calamites*. North of these lie grey, rusty-weathering, coherent slates and papery shales, with alternations of grey fine sandstone, probably of the Riversdale series, with a very high northerly dip. Blocks of grey sandstone are found as far as Abner McNutt's house and also on the road through to the Telegraph road, about a mile to the south-westward. In the west branch, from this road down stream to the fork of a branch from the left, are outcrops of greenish-grey and grey, flinty, jointed sandstone and dark bluish-grey shale; while above the fork in the left branch, and also down stream, are the red rocks of Union.

**North River of Onslow.** In Mingo's intervale on the south branch of North River the first rocks seen are dirty greenish-grey crumbly argillite, with bands of grey sandstone very quartzose and more or less flinty, full of rusty spots and resembling the Devonian rocks of Loch Lomond. Below Mingo's house the dip becomes nearly vertical and sandy flags are succeeded by a great breadth of black shales, succeeded again down stream by grey and greenish-grey, nearly compact, jointed, flinty sandstone, in thick and in flaggy beds. These extend to an old mill-

Coal.

Iron ore.

Contact with Carboniferous

dam, near which traces of coal have been discovered; and frequent outcrops of the flinty sandstone extend down to a bridge on the river, where they comprise flinty, jointed, flaggy sandstone with bands of dirty greenish-grey argillite. Thus far the river seems to show a descending section from the red and green rocks, altered by contact with the syenite, to the massive flinty sandstone of Mingo's, which may be that of the west branch of West River. The sandstone follows thence for a great distance nearly on the strike, the dip being very steep and perhaps indicating a fault complicating the anticlinal. Overlying the sandy flags, below a large brook from the right, appear again greenish and grey and blackish argillites, very ferruginous, including a few flinty bands and followed by massive somewhat argillaceous sandstone. Then, at the head of a piece of good interval, rise cliffs of reddish and greenish shale and sandstone or quartzite of the upper series, striking vertically 211°; but 200 paces to northward the dip is 3° < 80°. The river then turns to the south-westward, showing dark shales and rusty flags, which, 50 yards lower, dip 76° < 65°, indicating how much these strata are faulted or broken. Grey crumbly shales and red and grey sandstones and shales, lower down, dip 38° < 40°; then alternations of dark grey shales with harder bands, blackish shales with ferruginous plates and nodules, like the black shales of West River, extend to the Jollytown road. On this road to the left, these rocks probably extend to the top of the hill at the road to the left, beyond which the soil is Carboniferous. Most of the rocks of the river from Mingo's to the fork thus seem to be of the lower series.

On the Mingo road, grey flinty rocks continue to the Telegraph road, along which towards Salmon River are large outcrops of massive grey sandstone with a steep dip.

Fossil shells and plants.

Ironstone and limestone.

In the brook which crosses the Tatamagouche road about two miles north of the iron bridge at North River, greatly contorted grey and greenish-grey broken shales, containing *Naiadites*, probably the same as that of Riversdale, are succeeded higher up by grey flaggy sandstone, rusty-weathering argillite, and greenish, soft, smooth shales, showing indistinct markings of *Stigmaria*. Some of the grey shales have a purplish tinge. More flinty sandstones are seen higher up the brook, and similar rocks, with layers of ironstone and limestone, extend down the adjacent branch of McCurdy's Brook to the road at the contact of the Triassic. In the west branch of this brook—Turner Whidden's Brook—immediately underlying the Triassic, are, however, purple and greenish, mottled, somewhat sandy shales of the upper series, containing minute fragments of plants, interstratified with compact, thick-bedded sandstones, underlaid by light grey and cream-coloured, rusty-weathering, more argillaceous rocks, with the structure of underclay, holding rootlets and plants. In the joints is a film of blackish, shiny limonite; and in one layer of flinty sandstone a *vugg*, one inch in diameter, contains a mixture of red and brown hematite with the characteristic papillæ of the latter; but the rocks are much less altered than most of the iron ore belt. A half inch parting of blackish shale at the top might pass for coal. Up stream are banks of greenish-grey, crumbly, rusty-weathering argillite and flinty sandstone; and above the house, dirty-greenish and grey argillite, reddish, crumbly argillite, containing spherical concretions, and many blocks of light grey somewhat coarse sandstone, resembling Carboniferous rocks. Similar grey sandstones and shales occupy Baird's and Beaver Brooks.

Iron ore and coal.

North of Penny's Mountain the brooks show rocks belonging to both the subdivisions of the Devonian, indian-red soapy shales, dark bluish-grey, contorted, soft shales and rubbly, micaceous, flaggy sandstone producing a barren, rocky country like that north of Riversdale. The shales, as usual, contain rusty-weathering nodules and are sometimes ripple-marked. The contacts of these rocks with the Triassic and the Carboniferous limestone can best be studied from the map.

Penny's Mountain.

Contact with Carboniferous and Triassic.

In the river above the village of North River, greenish and grey, jointed sandstone is succeeded by a great thickness of black shale. Below the confluence of the south branch greenish-grey shales and sandstones with rusty-weathering nodular bands, marked with plants and containing thin layers of ironstone, alternate with dark shales to the confluence of the west branch, below which greatly contorted red rocks are occasionally seen, although the dark shales predominate to the Triassic. Similar rocks are found higher up the river, and below the bridge on the post road, dark shales containing rusty, hard bands of grey flinty sandstone which breaks into small pieces, are full of nodules and thin layers of limestone and ironstone and of shells like *Naiadites*. The dark contorted shales predominate and extend in great cliffs for some distance.

Black shales.

Fossil shells.

The sandstones associated with the coal are strikingly like those associated with the coal of West River and Kemptown, seem to be beneath the dark shales further down the river and to be inseparable from them. The limestone of the neighbourhood occupies the same position, apparently, with relation to the other rocks as that of Riversdale and Chiganois.

Coal and limestone.

Nuttby and New Annan.

On the road from Nuttby, past Tom McNutt's to Waugh River, rocks of this group are found. Near the fork of the road to New Annan the brook shows red argillite, with veins of ferruginous calcspar and calcareous concretionary masses. Further out are blocks of the grey quartzite of Riversdale. Then, at an old steam mill, grey fine grit is succeeded by coarse syenite and reddish, flinty porphyry, which occupy a considerable breadth and are then followed by a grey and blackish trap of Waugh River and Ferguson Brook.

Igneous rocks.

Middle Branch of North River.

Falling Brook is mostly occupied by red syenite and falls into the middle branch of North River over a cliff of that rock 40 or 50 feet high. In the river, sixty yards above the confluence, blackish or dark grey Devonian slates are closely pasted to the syenite, which is mixed with a bottle-green diorite, sometimes the syenite, sometimes the diorite predominating. About eight yards down stream black slate is seen among syenite and diorite which then occupy the river for more than half a mile to a little brook from the west. Here another direct contact is seen. At sixty-five yards above the little brook are the first outcrops of syenite and diorite, some of the latter being coarse breccia or conglomerate, perhaps mixed with sedimentary rock. Sixty-five yards below the little brook is a cliff of massive, grey, rusty-weathering conglomerate and grit, composed of syenite and felsitic debris, with a few layers of grey and dark shale full of minute plants. Dark grey and greenish-grey crumbly shale, with bands of grey sandstone, occur lower down, with others like those of the Coalmine Brook, certain flags being full of rootlets and of broken plants. The rocks are as rubbly as those of Riversdale and are cut by veins of white and dark calcite with siliceous matter like those of Tom McNutt's. Then follow alternations of flinty sandstone or quartzite and dark graphitic shale. There is here, perhaps, an intermixture of slaty rock and soft Carboniferous sandstone folded in among the faults, one band of conglomerate containing pebbles of blackish argillite. Near the head of the intervale, at the settlement, the dark grey and greenish, compact, flinty rocks contain specular iron which has been worked to a small extent. These rocks are unconformably overlaid by Carboniferous conglomerate.

Contact of Carboniferous.

Up the west branch of North River from the fork, dark grey or blackish, rusty-weathering shales, with light grey sandstones and a few coherent bands of ironstone or limestone, are interstratified with red beds, with a very high, often vertical, dip, and greatly contorted, and extend nearly to the bridge at the church on the Tatamagouche road. Near this bridge are cliffs of light grey, flinty, rubbly sandstone.

Devonian and Carboniferous rocks of Ishgonish.

Following the Devonian rocks to the Chiganois River*, they are exposed below the sandstones and conglomerates of the Staples Brook and Delaney settlements. From the Higgins road down Old Sam's Brook to the river, reddish and brownish sandstones and marls, with layers of grey sandstone, are similar to those which overlie the conglomerate in Great Village and Folly Rivers. These extend down the river from the mouth of this brook to the cliff beyond an old barn on the left bank. At the next cliff, however, are rocks from which they appear to be separated by a fault. Those first seen consist of a dirty, greenish-grey, crumbly shale or argillite, like that of Landsburg's; then four feet coherent, greenish-grey sandstone; then greenish-grey more shaly rock; then a faulted band of four feet coherent, greenish-grey sandstone; above which lie twelve feet of dark grey and blackish shales, holding *Cordaites*, and other fossils; then four feet and under of dark grey, compact limestone, the upper surface of which is covered with plants—*Naiadites*, *Coprolites* and other fossils; then about three feet blackish calcareous shales; then only indistinct outcrops of reddish crumbly sandstone. The limestone is like that cut by igneous rocks in North River, and among the dark shales are other thin bands of limestone. The next reefs consist of red and grey sandstone and crumbly shales which seem to overlie the grey rocks. They include at the base a band of greenish and grey, coherent sandstone, weathering rusty and marked with plants. Reddish, flaggy, jointed sandstone and shale occur again immediately below a large branch into the river from the left; and further down are long reefs of rubbly, reddish-grey sandstone and shale, followed by coherent flags showing green and grey spots marked with carbonized plants. The grey, coherent, fine flags beyond are overturned. A short distance below, at a reef and pool at a sharp bend, is a rock even more flinty than the above, underlaid by dark grey and greenish-grey shales, succeeded below by red and greenish, rubbly argillite, full of rusty nodules, and these by a great cliff of greenish flags full of *Lepidodendron* and other plants. These shales and flags are finely rippled on a great sloping cliff face. The upper part of the flinty band is an underclay. Blackish and dark grey, fine shales overlie it for a thickness of fifteen to twenty feet and are full of plants and *Cythere*. Down stream, and apparently overlying the last, come reddish, coherent shales and argillites, in no way resembling the Carboniferous, and in all probability representing the red rocks of Union. Beneath them are grey and greenish, coherent rocks; then a concealed interval, beyond which the flinty band above described forms a long

Fossils in limestone.

Fossil plants and shells.

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*An. Rept. Geol. Surv., vol. I., 1885, Part E, p. 46.

wall on the left, passes the river on a reef and rises on the right bank. Down stream and underlying is a great thickness of blackish, greenish and bluish-grey argillite. With these at a dam are many layers of flinty, greenish-grey sandstone. Below the dam the cliffs show blackish, papery, rusty-weathering *Naiadites* shale, with nodules and layers of limestone, one of which, two inches thick, has cone-in-cone structure. Then come cliffs of dirty red, rubbly, flinty sandstone and argillite, with a northerly high dip, underlaid by a strong band of reddish-grey sandstone, with *Calamites* and other carbonized plants; then reddish, flinty flags to the end of the cliffs. Beyond are reefs, chiefly of grey, coherent sandstone; then a long stretch of reefs of red rocks dipping nearly vertically and rising into a cliff on the left near the head of the clearings. To confound these flinty, fine, rubbly rocks with the coarse, flaggy, soft, evenly-bedded strata of the neighbourhood of Old Sam's Brook would be impossible. But that the lower series is equivalent to that classed as Lower Carboniferous at Hastings on the Strait of Canso is almost equally certain. The undulations of these rocks may be seen on the map. After an interruption of Triassic rock of about a quarter of a mile, similar rocks again appear in the river and exhibit a thickness of about 800 feet about a mile and a half above the railway bridge. They consist of dark grey, greenish and reddish, rubbly argillites, with spots of hematite, including a black, bituminous layer, one or two inches thick, containing traces of good coal, overlying a *Stigmaria* underclay, and associated with light grey, fine, flinty, jointed sandstone, with small veins and films of hematite, and bluish-grey, crumbly shales, with layers of light grey shale and dirty greenish-grey sandstone, with another layer of three inches of black shale largely composed of *Naiadites* and *Cythere*, with flinty, rubbly sandstone veined with hematite. There is a red band among the greenish and grey shales, and in one place five black bands in a width of ten feet, the more carbonaceous shales being crushed, polished and shiny.

Cone-in-cone limestone.

Coal and iron ore.

Above Higgins' mill, near the igneous rocks which form the celebrated fall of this river, is a compact grit or quartzite, a light grey, fine, flinty sandstone and a reddish, crumbly, fine sandstone with rubbly, flinty rocks, having an obscure dip, in contact with dark reddish, somewhat compact trap, succeeded by coarse syenite. In Higgins' Brook only two small outcrops of sedimentary rock are found among the felsites.

Contact with igneous rocks in Chiganois River.

The syenite and associated diorites extend to a point more than a mile below Patterson's old mill. We have then a breadth of a mile of slates. Those nearest the syenite on the south side of the belt are greenish and bluish-grey, having sometimes a fine tinge of red, papery, flinty and associated with greenish, flinty, felspathic sandstone like one of the gold-bearing series, full of reticulations of quartz and interbedded with whitish, massive, quartz-veined quartzite, so compact that the veins can be distinguished only by a slight difference of colour. Higher up are red, purple and green slates, with layers of crystalline limestone. White, rubbly, banded quartzites are the last of these rocks seen in contact with a pale flesh-coloured porphyritic or obscurely granular quartz-felsite or syenite at Patterson's mill and on the road from this mill eastward to the main road.

Crystalline limestone.

Debert River Devonian described by Dr. Ells.

Dr. Ells has described as Devonian* a belt of rocks 434 yards wide immediately beneath the Triassic in Debert River and unconformably overlaid up stream by the Lower Carboniferous. The Triassic rocks near the contact seem to be nearly horizontal, although down stream, near a spring on the right bank, nearly vertical. They are often more coherent than usual and have been used for building. On the left bank of the river, 110 paces above the last of the Triassic, are indefinite exposures of grey and reddish calcareous rock of somewhat coarse texture. On the right bank, 173 paces from the contact, are light grey, rubbly, coherent and heavy quartzose sandstones. On the left bank, about 200 paces from the contact, are similar flinty sandstones with dark bluish-grey shales, resembling rocks of Riversdale, well exposed for thirty-two paces. Then for 175 paces are occasional outcrops of grey and red rocks, nearly vertical, followed by a cliff of dark bluish-grey argillite, full of markings of stems of plants, rusty in the joints; rising, at nineteen paces, into a cliff ten feet high and, at 197 paces to a cliff twenty feet high, which shows layers of nodular ironstone and underclay. How these come against the red rocks seen at 212 paces is not very clear. They dip near the junction 143° < 50°, while the red rocks dip 354° < 50° and are slickensided. They may perhaps be cut off by an east and west fault which has also displaced them a little among their own beds. The red rocks resemble Carboniferous in colour and texture, comprising indian-red, fine sandstone and marl, with layers or patches of conglomerate in which the pebbles are sometimes larger than a hen's egg. A few paces up stream, a greenish-grey soft layer is full of carbonized plants; and higher up are reddish-grey, somewhat coherent sandstone and shale. The fault is about 100 paces below the mouth of Totten's or Graham's Brook. The coherent red strata extend up the river to a point less than three-quarters of a

Fault at contact with Carboniferous.

Coal of Cottam settlement.

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* An. Rept. Geol. Surv., vol. I., 1885, Part E, p. 43.

Fossil foot-prints.

Igneous rocks.

mile above the bridge at the Cottam settlement and include the coal seams. Above Totten's Brook they include patches of concretionary grit and certain flaggy layers have been quarried. One of the slabs showed, in addition to fucoids, tracks of *Sauropus*. The lower rocks resemble those of Turner Whidden's and the vicinity. When they again appear above Cottam settlement[*] blackish graphitic slates are in contact with greenish and grey, soft, slaty, volcanic breccia and massive felsite, containing films of red hematite in the joints, succeeded by greenish and grey flinty, porcellanous flags with ironstone bands, followed by gneissic rock and by light grey, granular, fine and coarse diorite or diabase.

In the Millbrook that comes into the river from the eastward at Cottam settlement, dark bluish-grey, light grey and greenish-grey, flinty, quartz-veined sandstone or quartzite, rusty-weathering, whitish, compact quartzite and argillites are associated with dioritic and grey syenitic rocks.

Carboniferous and Devonian rocks of Totten's Brook.

Iron mine.

Plants.

Erect tree.

Syenite and diorite.

The rocks of Totten's Brook, from the confluence with the river to a short distance above the road through the back settlements, are, like those of the river, Carboniferous. At their contact with the iron ore rocks they are brecciated as if at a fault. These latter consist of light grey sandstone, with rusty-weathering patches and greatly veined with quartz; of black, slaty, rubbly, graphitic argillite, with small veins and lenticular patches of ankerite. Then follow outcrops of igneous rock, above which are the sedimentary rocks holding the iron mine of the Peter Totten meadow[†]. These extend nearly to the head of the brook and consist of grey, rusty-weathering, rubbly, flinty sandstone, massive or flaggy, with layers of reddish, bluish-grey and greenish, flinty argillite, presenting numerous graphitized markings of minute plants. In the east branch, north-east of the iron mine, greenish and grey, massive and flaggy, rubbly, fine sandstone or quartzite, with minute plates and veins of ankerite and of spathic iron, films of limonite and hematite, like that of Grand Lake and Guysboro', is exposed in fine cliffs. In one place among the sandstones is a spot as if a tree had grown there; no rootlets, however, could be definitely made out, although in certain dark rocks surrounding it fragments of carbonized plants, apparently *Cordaites*, abound; and even in the flinty, micaceous flags, where they are not too much felted together or veined, minute plants are observed. Above the quartzite come dark slates and pyritous argillite veined with calcspar, followed up stream by syenite and diorite.

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[*] An. Rept. Geol. Surv., vol. I., 1885, Part E, p. 45.

[†] Geol. Surv. Progress Rept., 1872-73, p. 22.

Pine Brook.

The rocks of Pine Brook, from the Triassic up to and for half a mile above the Base-line road, are described by Dr. Ells as Lower Carboniferous*. Succeeding them are blackish and dark grey, curly, papery, silky, graphitic slates with nodular or lenticular masses of siliceous and calcareous rock. They closely resemble the slates of North River, but are much more altered. Above a mass of volcanic rock a short distance up stream are light grey and cream-coloured siliceous and argillaceous, massive and compact rocks, intersected in all directions by veins of ankerite sometimes two feet thick, on the surface of and in cracks of which specular iron is found in masses six inches thick and downward. Specular ore is also found in separate veins and films in rock precisely like that of Cook's Brook, of which the less metamorphic portions have a strong resemblance to underclay. Higher up are larger veins of ankerite and specular iron; and pieces of limestone like that of Tom McNutt's are found in the slates. Though grey and greenish and cream-coloured rock are associated with purple and greenish porcellanites, certain sandy micaceous flags and argillites show markings of *Cordaites* and other plants which are somewhat obscure; but in the bed of a little brook from the west is an underclay full of rootlets and of impressions of *Calamites* which leave no doubt of the age of these Devonian metamorphic rocks.

Specular iron ore near contact with dykes.

Underclay full of rootlets.

Iron mine.

Higher up, at the contact of red and green slates with greenish breccia, is an opening on a band two feet thick impregnated with specular iron, the ore having, in one place, a thickness of seven inches, but being lenticular. Above these volcanic rocks, which are of some breadth, sedimentary rocks again appear.

Londonderry East Mines.

Folly River.

In Weatherbe, Gory, Slack and other brooks of East Folly Mountain similar rocks yield the iron ores of the East Mines, but they require no special mention. Folly River† next exposes fine alternations of Devonian in contact with igneous rocks. A deep railway cutting at the snowshed immediately south of the siding at the foot of Folly Lake shows whitish and dark fine flags and striped quartzites, with a layer of conglomerate, very greatly altered and resembling the metamorphic rocks of James River and the Atlantic coast. Intermixed with the massive igneous rocks is a chloritic slate or schist. Soon, however, diorites occupy most of the cuttings, and only small patches of sedimentary strata are met with. In Folly River, before the railway leaves it, not far above the east branch, they are again, however, seen full of layers and reticulations of quartz. Below the diorite at the fork of the east branch, the rocks are massive, light greenish-grey, quartz-veined sandstones, containing veins of rusty-weathering spathic iron, overlaid by flinty quartzite. Lower down, the river is wide and shows light-coloured quartzose rocks, veined with quartz and ankerite, some of the quartz veins holding also traces of specular iron. Down stream occur grey slates, like the Devonian rock which carries the specular iron in Guysboro' and Antigonish counties, overlaid by black graphitic slates, with threads or plates and masses of ferruginous calcspar, interstratified with red and green, mottled, soft, soapy argillite. Succeeding these slates almost immediately on the left bank is a cliff of reddish coarse conglomerate, with pebbles of the flaggy, flinty quartzites and of light-coloured diorite and syenite, belonging to the Carboniferous. By a fault on unconformity the slates are sent to the right, up a small brook from the river, while immediately north-east of them is a slickensided felsitic rock.

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*An. Rept. Geol. Surv., vol. I., 1885, Part E, page 45.

†An. Rept. Geol. Surv., vol. I., 1885, Part E, pp. 47-53 and 56.

Contact with Carboniferous

Railway between Folly Lake and Londonderry.

Following the railway, banded, altered argillites succeed a greenish fine diorite, and about 115 yards south of the school near the foot of Folly Lake, are associated with light grey, flaggy quartzite. Mixtures of slate and diorite then extend for some distance, certain whitish quartzose flags including quartz veins supposed to contain gold. In one of the cuttings light-coloured strata are interstratified with blackish, coarse hornblende rock or fine diorite, which follows in the bedding for some distance. The quartzites end at a dyke of red compact quartz-felsite or syenite, five feet wide, which runs up eight feet vertically to meet this diorite. Blackish diorite then comes below the syenite; one of the lenticular veins in it is ten feet wide. The whole section from the siding to the contact with the Carboniferous is about three miles long. For thirty-five chains from the school, sedimentary rocks predominate; then for more than three-quarters of a mile none but igneous rock; then nearly a mile with occasional bands of sedimentary rock among diorites; then twenty-nine chains of sedimentary rock to the 82nd mile-post, where the Lower Carboniferous begins. The sedimentary rocks among the diorite are greenish-grey, rusty-weathering, but with some bands of red argillites, quartzites and flags; greenish-grey and dark grey argillite; fine grits with ankerite in the joints. Certain rusty, shaly layers show abundant traces of graphitic or anthracitic matter; one bed shows obscure rootlets, graphitized marks of plants and stains of copper. Near the 82nd mile-post the rocks are very ferruginous, light grey, cream-coloured, quartzose and soft. The last seen in the little brook at the con-

Dykes.

Obscure plants.

tact are blackish, soft, crumbly, graphitic slates with light-coloured calcareous and ferruginous nodules and lenticular beds of light grey compact sandstone or quartzite, unconformably overlaid by conglomerate holding pebbles of all these rocks. Contact of Carboniferous

McElman Brook empties into Folly River from the west immediately above the high bridge on the railway, displaying, at and for three-quarters of a mile above the river, Triassic coarse sandstone and conglomerate. Up the east branch (Urquhart Brook) for about half a mile are somewhat flinty, red and rusty-grey sandstones and shales, full of fossil plants, rubbly and slickensided, veined by calcite and with films of limonite, of doubtful age, but perhaps Carboniferous, succeeded up stream by coarse beds, undoubtedly Carboniferous. Not far above the railway these give place to dark and light greenish-grey, flinty, brecciated, greatly altered rocks, with nodules and veins of bluish-grey, rusty-weathering calcite, precisely like the Devonian slates on the left bank of the East River at Sunnybrae. They are graphitic and twisted, and are succeeded by light greenish or cream-coloured, rusty, fine rocks and by flinty sandstones and argillite, cut by many rusty veins. Next comes massive quartzite, with dark, plant-bearing flags and occasional purple beds, broken by igneous rocks, above which greatly altered quartzose flags and argillites, apparently underclays with intercalated layers of blackish shale, show markings of plants. Whitish, compact, slaty quartzite, greenish micaceous rock, light grey, flinty and dark grey porcellanous argillite extend to the head of the brook, but are interrupted in many places by diorite.

McElman Brook.

Trias and Carboniferous.

Devonian.

Fossil plants.

Diorite dykes.

The Triassic rocks of the west branch of McElman Brook (Phillips Brook) come vertically against reddish and greenish-grey strata, probably Carboniferous, holding streaks of coal derived from trunks of trees. They are, however, immediately succeeded by more flinty rocks, which may be lower, but are again succeeded by Carboniferous, at the base of which is a conglomerate, in contact, above the railway, with greenish and bluish-grey Devonian slates, including a lenticular mass of grey, flinty quartzite, interstratified with rusty-weathering quartzite, very like underclay, holding obscure, carbonized plants. Up stream, greenish, soft, papery slates, mottled, purple and greenish or cream-coloured slates, with stains of specular iron, light and dark grey slates veined with ankerite, and flinty, fine sandstone, with a large proportion of red—not unlike the rocks of the other branch, but without igneous intrusions—extend to the head of the brook. Great masses of spathic iron ore have been taken from an opening in this brook.

Fault at contact of Trias and Carboniferous.

Iron mine.

Saltspring Brook.

Above the Base-line road on Saltspring Brook, Carboniferous conglomerate is again seen in contact with grey, flinty sandstone or quartzite, dark shale or slate, with a large proportion of bright red argillite with grey and black blotches, at a little brook from the eastward. Higher up the main branch are good exposures of dark grey and greenish, contorted, flinty and soapy shale and quartzite, with patches of red and purple argillite, of greenish and cream-coloured argillite and of grey, thick-bedded, compact sandstone or quartzite, rusty-weathering and sometimes veined. These extend to a fall, 30 feet high, over greenish, soft and hard chloritic trap or diorite, containing films of red hematite and succeeded by grey or blackish, crystalline diorite, intermixed again with rusty slates and quartzite at the head of the brook. In the pasture lands to the northward are dark, dioritic rocks, associated here and there with patches of sedimentary strata. From these clearings, down the brook which runs westward to Great Village River, nearly all the exposures are of massive, dark, crystalline diorite, red quartz-felsite or syenite, more or less compact, with only one or two patches of obscurely-bedded, flinty rock, which may be sedimentary. The diorite is interrupted by dykes or masses of reddish, compact syenite or quartz-felsite, with blotches or little lenticular veins of quartz.

Sedimentary and igneous rocks.

Great Village River.

### F. 3.—Upper Devonian.

Distribution.

The upper beds of this formation are most widely distributed in a tract which lies north of Stewiacke River and south of the railway between Riversdale and Truro stations, and in the country south of Cobequid Bay.

Iron ore belt.

A narrow belt of rocks of a lower horizon, including green and rusty ferriferous slates, extends from Sunnybrae to join the large area along the Middle River of Pictou. These will be first described.

Bridgeville.

In Archibald Brook, unconformably underlying the Carboniferous rocks near Bridgeville, are greenish slates cut by soft trap, followed up stream by dark grey twisted slates, veined with calcspar and interstratified with yellowish-grey brecciated quartzite, full of blotches of ankerite. Certain red flinty quartzites and argillites of the neighbourhood are, perhaps, equivalent to those of Union. Running in the bedding of reddish and greenish-grey, flinty, micaceous sandstone or quartzite, twisted slates, greenish and cream-coloured, porcellanous, flinty, ferruginous rocks higher up the brook, are lenticular veins of ankerite sometimes ten inches thick. Greenish and grey, very flinty, rocks just below the road at Archibald's mill resemble those of

Iron ore.

Slates prospected for coal.

Roofing slate.

Roman Valley, while immediately above the mill is a bank of black graphitic slate worked for coal; and up stream the bluish-grey slates of the Mira Falls, like which they are supposed to be fit for roofing*.

Dykes and veins.

Mines of specular iron ore

Similar rocks occur in the lower part of John McDonald's (Ogg) Brook, the bluish-grey soft shales of the post-road being succeeded up stream by reddish and greenish calcareous slates, and, 210 yards above the bridge, by dark slates, containing thread-like markings of plants, cut by dykes of trap and diorite and by rusty bands of ankerite, with grey quartzite and other rocks of the lower group, veined with quartz and calcite. The openings in iron ore on the east side of the brook are in grey, rusty-weathering, flinty, quartzose rock. In the brook south of the openings dark slates are well exposed and contain an immense quantity of ankerite in irregular veins, sometimes of great thickness. The rock containing the specular iron ore at John McDonald's (weaver)† is very like the flinty and soft rocks of Londonderry. In the brook above mentioned, at a little brook from the west, rusty rocks of this description on both banks contain small pockets of specular iron among veins of ankerite, and in contact with igneous rock.

At the Centredale school, whitish quartzite and black slate succeed the Carboniferous. In a little brook which flows into the East River, between St. Paul's and Bridgeville, red rocks belonging to this group are associated with very flinty, grey quartzite and with grey, fine, calcareous flags and shales, veined with threads of calcspar, which extend to the road up the river. Near the fork of the Centredale Brook and that from Maple Lake, the purplish argillite and sandstone, grey, greenish and dark, jointed, splintery argillites and quartzites are probably of this age, as well as the reddish and greenish siliceous sandstones and argillites of Elgin, which hold minute ferruginous veins. Here, as in the west branch, they are overlaid by Carboniferous limestone.

West Branch of East River Pictou.

In the West Branch, above the bridge at Elgin, are reddish, flinty, jointed rocks; sparkling, fine quartzite, with layers of greenish and purplish, slaty argillite; dark slates; greenish, soapy slates veined with quartz; blackish, graphitic slates, sometimes flaggy, including bands three inches thick and downward of ferruginous limestone or ankerite; greenish-grey and reddish, soapy, papery shales. Red argillite predominates. Occasionally a greenish quartzite, tinged with red, has rippled surfaces and pyritous lenticular layers, and the grey and greenish flags resemble those of Big Brook. Up stream they are succeeded by the grey slates of the Middle Devonian.

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*An. Rep. Geol. Surv., vol. II., 1886, Part P, p. 56.

†Trans. N.S. Inst. Sc., vol. II., p. 67; vol. III., p. 171; vol. V., p. 206; Progress Report Geol. Surv., 1866-69, p. 408.

Big Brook.

The rocks of Lorne, south of the gypsum, are shown both on the Big Brook road and on that to Trafalgar. From Kenneth McKenzie's to the Glengarry railway station, by way of John McDonald's, all the debris points to the country being underlaid by Carboniferous and by the red Devonian rocks. From the bridge over Big Brook on the Trafalgar road, to the road on the left to Elgin, the dark, coherent argillites are, no doubt, equivalent to those on the road near Kenneth McKenzie's. South of the plaster land are outcrops of red and green slate, like that of the west branch above Elgin. Above the fork of Cross Brook, Big Brook exposes greenish-grey, fine, pyritous, flinty sandstone and argillaceous shale, succeeded up stream by light greenish, soft argillite, blackish argillite or soft slate, with nodules and lenticular bands of black calcveined limestone, very much broken and associated with diorite, followed by reddish, fine, rubbly, argillaceous sandstone, and near the mill by the Middle Devonian slates.

Cross Brook

The rocks of Cross Brook, like those described above, are perhaps equivalent to the coaly strata of west branch and Kemptown. Above the road they consist of light grey, rusty-weathering, fine, micaceous, flinty sandstone, or quartzite and argillite, sometimes slaty, of blackish and light grey argillaceous shale, with bands of micaceous sandstone, well-bedded, but jointed and sometimes slaty. Some of the graphitic shales have been mined. Immediately succeeding these rocks are dark slates and quartzites.

Black shales.

Middle River of Pictou.

From Lorne to West River the railway seems to follow closely a band of Upper Devonian. In the fields south of Glengarry railway station, reddish, purple and greenish, flinty argillites and quartzites are in place to the back road, and on this road westward along the railway are associated with traps. To the north, reddish-grey argillite and sandstone, in thick beds veined with quartz, appear in the Middle River, and similar rocks, resembling also those of Big Brook, abound on the roads towards Whitehill and Marshdale. On the road from Lorne to Glengarry the rocks are no doubt also of this age, the huge blocks of veined diorite indicating the igneous rock so often seen in the same position, cutting no higher rocks than Upper Devonian; and the black slate mined at Jesse Grant's is perhaps the same as that of Cross Brook, of the Big Brook and other places. The rough land east of Glengarry is covered with blocks of white-weathering, flinty sandstone. About one hundred yards west of the station, a cutting shows purplish slaty argillite, and on the road to the northward are grey and purplish coherent

Igneous rocks.

rocks. Near the railway tank are grey, coarse sandstones and bluish-grey shales, not unlike Carboniferous. Other cuttings show greenish and grey, coarse, flinty grit, dirty greenish-grey, bluish-grey, red and green crumbly shales; and black shales, which would seem to be about the horizon of the coal of West River, have been dug for coal in a shaft and several pits in this neighbourhood. Some of the associated sandstones are very siliceous and resemble the Guysboro' quartzites and rocks of the Salmon River west of Riversdale, which underlie the red and green rock of Calvary Stream. Search for coal.

On the road from Glengarry to the fork of the Middle River, the green slates are Devonian, as well as rocks associated with the trap below the bridge. Some distance above the bridge, a flinty quartzite is in contact with greenish coarse diorite, among which is a breccia containing pebbles of the cream-coloured siliceous rocks and argillites.

Apparently most of the rocks of the magnificent outcrops above the fork of Middle River in the west branch, as far as the railway crossing at Lansdowne, belong to the horizon between the Middle and Upper Devonian. Those first seen comprise greenish-grey, fine, flinty, argillaceous sandstone, in shales and flags, with layers of polished graphitic slate and of flinty quartzite. They are traversed by veins of ankerite, and by minute veins of quartz, one of which yielded specks of copper pyrites. Up stream are red, slaty argillites, with bands of green, and a greenish grit, perhaps Carboniferous; succeeded by cliffs of purplish, flinty, splintery, massive, jointed, micaceous, argillaceous sandstone or quartzite, cut by threads of quartz and spotted with rusty grains and bright green blotches, sometimes calcareous, and in one place passing into impure limestone; and still higher, fine outcrops of purplish, coherent argillite and sandstone, with bands and reticulations of green, veined or blotched with quartz, and ripple-marked, followed by greenish and cream-coloured argillites, purplish rocks with plates of spathic iron and large cream-coloured blotches, greenish and light grey, flinty, argillaceous and siliceous rocks, with light grey, very pyritous, rusty-weathering bands, most thick-bedded, also a greenish and grey, massive, rubbly, rusty-weathering siliceous rock, with ferruginous veins. Specular iron accompanies a band similar to that of the iron-bearing rock at the Roman Valley, Caledonia Mills, South River and elsewhere. Reddish, greenish and grey rocks extend to Matheson's Mills. Copper ore Iron ores.

Good exposures of the red and green rocks occur in the brook from the mill-pond immediately north-east of Lansdowne station and on many of the roads of the neighbourhood. The first rocks seen Lansdowne below the pond are greenish, rusty-weathering, somewhat massive, rubbly, ferruginous, siliceous and argillaceous, containing a quantity of specular iron and ankerite. Lower down the greenish are associated with purplish beds, also containing veins of specular iron ore, one of which, one inch thick, cuts across the bedding, and of ankerite, sometimes more than a foot wide, in part converted into specular ore.

Gordon's Summit.

Igneous rock.

On the railway near the 29th mile-post are blackish graphitic slates, and light grey, crumbly, granular, quartz-felspathic grit, dug from iron. At Gordon's Summit, rusty-weathering, siliceous rocks are followed by flaggy, and by a greenish-grey and grey argillite and quartzite to Matheson's Mills, sometimes associated with volcanic material. At the head of a branch of Middle River, near Gordon's Summit, purplish, bluish-grey and grey argillite and compact sandstone, the latter containing many veins of specular iron, are associated with greenish and grey slates. At the fork of Dan Matheson's Brook the river exposes red sandstone and argillite, together with grey rocks like those of Roman Valley.

West River, Pictou.

Fossil plants.

Contact of Carboniferous

The rocks near Campbell's siding, include a great thickness of red, crumbly argillite; but a large portion are of rubbly, flinty, slaty argillite at a little brook further east. The dirty greenish rocks further east have among them layers of flinty sandstone or quartzite, and also of black *Cordaite* shale and crumbly, greenish and reddish argillites, of which there is a great thickness near Landsburg's. The cuttings near the county line, and those near Jonah Langille's show red and green flinty flags. On the road from Langille's to the main road at Landsburg's, the debris seems to indicate greenish and purple slates, and along the main road eastward the grey rocks of Riversdale, numerous blocks of which are seen near the West River road. To left, down the river, the land on the right and left is very rocky as far as a little cemetery, the grey, flinty, quartz-veined quartzites show as far as the river bank. Then the land is better as far as the ford and foot-bridge, below which, grey, rusty-weathering, flinty rocks are again apparently in place as far as a small brook near a house on the left, where the hill turns to westward and the overlying conglomerate begins.

On the east bank of West River the debris hereabout is of blue-purple rock, not of the colour of the rocks of Union. If as seems probable the rocks of the left bank are beneath those of the right, this would imply either a great bend of the strike from east to south, or a great fault carrying the purple and green rocks of the east side far south past the grey underlying series. The road on the east side shows the grey rocks only at the end near the station.

Riversdale and Stewiacke

The Riversdale rocks almost certainly underlie those of Union, and a great tract of the intermediate series seems to occupy the country north of the railway, being spread over a great area by frequent folds and faults, some of which can be indicated with considerable accuracy; a great area of black slates seems then to succeed that of the Riversdale rocks and to be repeated in the same manner at the head of Stewiacke River and south of the East River of Pictou.

Devonian of Mount Thom.

Dykes.

Carboniferous rocks north of the railway.

Coal.

On the track north from Campbell's Siding, about a quarter of a mile south of John McKay's, Devonian rocks are found which connect those of the south with the rocks of Mount Thom and the east end of the Cobequid Hills. They comprise green, light grey and purple pearly slates, with whitish quartzites, intersected by dykes of diorite. On the road to the west end of Mount Thom, are reddish and cream-coloured argillite and rusty-weathering quartzite, veined with ankerite; and similar slates are everywhere in the vicinity. The rocks of this track south of the crossing of a branch of Black River, consist of grey and reddish fine sandstone and grit, very shaly, associated with coarser rocks and probably belonging to the Carboniferous series to the northward. Near the railway they are rusty-weathering, finer and argillaceous. From where the track strikes the railway, the first cuttings to the eastward show dirty greenish-grey and grey, rusty-weathering, crumbly, argillaceous sandstone and shale; underlaid by reddish marly rocks resembling those below the fork of Middle River, and succeeded, further east on the railway, by dirty, greenish and grey rocks and black carbonaceous *Cordaite* shales, containing layers of slaty bituminous coal which have been dug and which appear in two of the cuttings to the eastward.

Calvary Stream.

Iron mine.

Dyke.

Nearly all the rocks of Calvary Stream below the driving-dam, three miles above the railway, lie between the grey rocks of Riversdale and the red rocks of Union. Near the dam they are massive, full of iron pyrites, and veined with quartz and ankerite; certain bands of light grey, often flaggy, sandstone show bright red blotches. The greenish and grey, wrinkled, shaly rocks of the cliffs at the dam, at the iron mine, are much more flinty than the rocks above it, perhaps because of the proximity of volcanic rock. Below the dam is a white-weathering, green slate and a wrinkled, scaly, graphitic, polished slate, full of quartz veins, succeeded downstream by cream-coloured slate, ribbanded flags and a small outcrop of trap. Below, are grey, rusty-weathering, crumbly shales, underlaid by light grey Guysboro' quartzite, again underlaid by flags, breaking into bricks.

Limestone.

These lie at the mouth of Johnny's Brook (which flows from Island Lake) up which are the red rocks of Union. A band of five feet of impure limestone is found in Calvary Brook, not far above the railway, * among light-coloured flinty sandstone and shale, veined with milky quartz. Then come, up stream, red rocks with green blotches, with minute veins of ankerite and calcite, and a patch of greenish conglomerate. Black slates with lenticular patches of grey sandstone are interstratified, near the mouth of Brown's Brook, with whitish, very flinty, coarse quartzite or grit, veined with quartz, of great thickness, with greenish, grey and reddish, ripple-marked, flinty flags, veined with quartz and ankerite, and with blackish shales with a few nodules of ironstone. Outcrops are nearly continuous to the driving-dam and are also found in the tributaries. The dip is very high and the strike along the brook perhaps indicates a large fault which may be an extension of that which follows the East River of Pictou.

In Johnny's Brook, near the river, are dark bluish-grey graphitic slates, overlaid by whitish, quartz-veined quartzite. Up stream are cliffs of light grey, fine, somewhat soft, micaceous sandstone and greenish compact quartzite, overlaid by a reddish, massive, quartz-veined quartzite; and, at a track from the driving-dam, by reddish and greenish, somewhat crumbly, argillite. Above the track the dip is up stream at angles varying from 50° to 80°, and the rocks are those of Union—reddish and whitish spotted sandstone or quartzite and argillite, veined with quartz. Greenish and grey slaty argillite and quartzite occur with the red rocks near Island Lake, and on the hauling road to the Pembroke road, on which, towards Riversdale, red rocks show occasional green layers. In Brown's Brook are light grey and greenish quartz-veined quartzite, in thick beds with red and light grey, glistening, coarse, flinty, quartz-veined, quartzose sandstone, resembling that of the main brook.

Stewiacke River.

Carboniferous conglomerate.

Beneath an unconformable covering of gypsum which occurs on both sides of Stewiacke River near Crockett's at Eastville, lie red and purplish strata like those of Union, veined with quartz, containing bands of greenish sandstone, and probably overlying the grey rocks seen higher up stream, as they do at Salmon River, although the steep dip renders this difficult of determination. At Cox Brook is another outcrop of red rocks, probably of this age, underlying a conglomerate which seems to be identical with that

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*Sir J. W. Dawson states that he has collected at Riversdale [Lower Carboniferous Plants, pp. 29-34] *Calamites Cistii, C. cannæformis, Odontopteris antiqua, Cardiopteris ?, Hymenophyllites furcatus.*

which overlies grey quartzites and slates of the gold-bearing series at the Newton Mills iron mine. The exposure of these upper rocks in the river is narrow, but on some of the lower tributaries larger areas of them come from beneath the Carboniferous limestone, as at Glenbervie, where the latter is succeeded by the red rocks of Union, and on the parallel road from the Smithfield lead mine, where red argillites alternate with grey, rusty-weathering rock, often coarse and pebbly, and with whitish, massive quartzite. On the road near Harmony and also at Manganese Mines, precisely similar rocks underlie the Triassic, and will again be referred to.

Carboniferous limestone and gypsum.

In the Little River of Stewiacke, at and near a fork above the head of the settlement, red Devonian rocks are exposed, and, about two hundred and ten paces below the fork, are in contact with grey and dark flaggy Carboniferous limestone, dipping 277° <43°. Lower down near a bridge, are great outcrops of gypsum, north of which lie grey flaggy sandstones, like those of the Goldmine Brook, succeeded almost immediately by the red rocks of Union, including a grey rusty-weathering sandstone and coherent flags, with many markings of plants, which extend northward to a branch, and down this branch to the river at the two bridges near Leander Nelson's. On the road up the river from these bridges, flaggy sandstone and whitish quartzose grit, like those of the Goldmine Brook, perhaps indicate that these latter belong to the limestone and gypsum series. Along the most southerly of the two roads at Brookfield iron mine a strongly marked valley runs 254° towards Little River. In and immediately north of this hollow lies the iron ore, the rocks of both hills being those of Union, including, next the ore, a grey spotted, flaggy sandstone. Down Little River, Devonian rocks extend for thirty-five paces below the road to the iron mine, and are then succeeded by grey bituminous Carboniferous limestone, dipping 174° < 60°, and overlaid by grey, soft, rusty-weathering sandstone and gypsum. The boundary closely follows the river for a great distance down stream.

Brookfield iron mine.

Salmon River.

The almost unbroken section in Salmon River is clearly a descending one from the rocks of Union to the mouth of Black River, the red of the strata being interrupted by only a few little bands of dirty green. About 200 paces above the mouth of Black River they are succeeded by massive, rusty-weathering sandstone, underlaid by whitish, fine and coarse quartzite, veined with limonite, including thick beds of very flinty conglomerate with pebbles, as large as a hen's egg, of quartz, syenite and green slate, which

Iron ore

Fault.

Specular iron ore at a dyke.

Carboniferous and Devonian of Steel's Run.

Iron mine.

Mount Thom.

may possibly indicate unconformity between these and the lower rocks ; the dip, however, is nearly vertical and the bedding-planes are finely polished or slickensided. The rocks of this vicinity strikingly resemble those of Grand River and Guysboro', and the country underlaid by both is precisely the same. Higher up, alternating with red beds, vertical or overturned, are whitish red-spotted quartzites, like those of Johnny's Brook ; bright green and purplish, fine quartz-veined argillite and greenish rusty-weathering or cream-coloured flinty quartzite, precisely like those of Londonderry mines, with darker grey and greenish bands, very much altered, containing specular iron and ankerite, and succeeded immediately by a small dyke of diorite. Up stream from the diorite are cliffs of dirty greenish, grey and dark bluish-grey argillite and flags, with bands of grey rusty-weathering sandstone, perhaps equivalent to the rocks of Riversdale, but succeeded immediately below the Telegraph road by the red rocks. There is no doubt that these rocks are frequently repeated by faults. Strata of the intermediate series are abundant in Steele's Run, but those first seen above the mouth are argillite and flinty sandstone of the Union series, overlaid by a conglomerate in detached masses, and evidently newer than Devonian. Beyond the conglomerate, are red or purple argillite and quartzite, succeeded by light cream-coloured, rusty-weathering strata, mined here some years ago, containing scales of specular iron and minute veins of ankerite, quartz and calcspar. They are finely striped or banded, but often too massive to show the dip, include bands of greenish pyritous slate and of pearly slate and grey and bottle-green and whitish, compact, rusty-weathering quartzite. The cliffs immediately below the saw mill contain a considerable quantity of red hematite in blotches and threads. The specular iron seems to indicate the proximity of igneous masses such as come to the surface in the adjoining country. Above the saw-mill the brook comes through marshes and intervale, but on the road are outcrops of purplish rock which extend to Mount Thom*.

Earltown.

On the Salmon River road near Earltown, succeeding the syenite of Upper Kemptown, are red and green flinty rocks perhaps of this age; but they require further examination to separate them from the Silurian of the vicinity.

Iron ores.

Above Jacob Fenton's, the Salmon River shows good outcrops of greenish-grey, flinty, rusty-weathering, ferruginous rocks, with patches of botryoidal limonite, alternating with other red and grey rocks as far as the foot-bridge at John and David Ross's. Similar rocks, also containing a considerable quantity of limonite, have been worked in Upper Kemptown at several places. Between Kemptown and Upper Kemptown are indications of the red rocks of Union, and some of the large blocks of rusty-weathering Devonian rock which are abundant on the Telegraph road east of the road to Mount Thom contain traces of botryoidal limonite. On the road to the left from the mill, debris of purple and green Devonian slates and of grey flaggy sandstone and shale is seen as far as the clearing of John and David Ross.

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* Acad. Geol., p. 502.

Upper Kemptown.

Whether or not newer rocks occur on the road between Kemptown and Upper Kemptown is somewhat obscure; the red rocks are perhaps all of the Union series. But there is no doubt of the Devonian age of the rocks of Matheson Brook, the first stream to eastward north of the post office, which flows over red and green slates not far below the road, and, about half a mile below it, dashes down fine little falls composed of grey, compact, flinty, rusty-weathering slates, succeeded down stream by all the rocks of the river below the Telegraph road, including light grey, bluish-grey and greenish-grey quartzites, of considerable variety of texture, more altered than usual. Salmon River, above the mouth of Matheson Brook, exposes rocks like those of the Red Bridge, sometimes massive and crumbly, with several red beds. These extend to the mouth of Ross Brook, where many blocks perhaps indicate the beginning of the syenitic rocks of the mountain, which are in place higher up. In Ross's clearing and on the road to the eastward, as described above, and in the fields as far as Pat McAulay's clearing, Devonian slate abounds. Red and grey Devonian rocks apparently follow the Telegraph road from McAulay's westward to the Riversdale road, and extend southward along the latter nearly to the top of the hill where the dark slaty strata of Riversdale and the vicinity begin.

Syenite of Salmon River.

The strata of Salmon River about a quarter of a mile below the mouth of Black River are perhaps near the base of the red rocks of Union. They comprise indian-red and purple, coherent, flaggy rocks, striped with lighter colours and interstratified with beds of softer, crumbly argillite, resembling the rocks of Rocklin, underlying which is a thick bed of rusty-weathering, glistening quartz-veined sandstone or quartzite.

Up Lamby's Brook, two miles west of Riversdale, red quartzite and argillite are interbedded with whitish quartzite. At Allan's logging road in this neighbourhood are blocks of light-coloured sandstone or quartzite, spotted with hematite, and of flinty con-

Brooks between Riversdale and Union.

glomcrate, like that of Salmon River near the fork of Black River. Narrow Mouth Brook, below the logging tramway, shows good outcrops of light grey, massive sandstone, of somewhat coarse texture and very coherent, among a great mass of red rocks. Reddish and greenish flinty flags and shales and whitish quartzite are also found up along the tramway; and on the track past Moose Lake are light grey and whitish quartz-veined sandstone and quartzite, apparently belonging to the intermediate series, although no iron ores appear yet to be discovered in this vicinity.

About half a mile above the Greenfield Brook a little brook enters Salmon River from the north, showing, for some distance up stream, reddish and rusty, quartz-veined flags and argillites, white-weathering, forming rocky barrens like those of Loch Lomond and Grand River*.

Greenfield Brook.

Greenfield Brook shows fine outcrops of these rocks in as great volume apparently as is exposed on the railway. Immediately above the railway are cliffs of bright red, crumbly, micaceous argillite, with flinty layers and bright green spots covered with broken carbonized plants. They resemble the red rocks of Rocklin and Concord. Higher up they are more sandy, jointed and flinty, include a band of bottle-green, ribbanded, flinty, fine sandstone, and exhibit lines of jointing at right angles with the bedding. A short distance up, at a turn of the brook, is a very compact, reddish and greenish, glistening, micaceous, red-spotted quartzite, like that of Salmon River and the Pembroke road, breaking into blocks which encumber the almost barren surface of the land adjoining the brook. Higher up are greenish rocks veined with quartz, and above the Greenfield settlement similar rocks extend towards Smithfield, and are exposed in all the little brooks of the neighbourhood.

Diorite east of Valley.

East of the cross-roads near Valley, the Telegraph road passes over red flinty rocks in contact with coarse diorite. With the former are interstratified greenish quartz-veined rocks containing minute veins of limonite.

Henry Christie's Millbrook.

Manganese ore.

In Henry Christie's Millbrook, Triassic rocks are underlaid by light grey flinty quartzite, with minute veins of white quartz, succeeded up stream by indian-red quartzite and argillite, well exposed in rough falls and exhibiting numerous veins of white crystalline quartz, some of which are nine inches thick, contain traces of crystalline pyrolusite and have been worked. For some distance above the mill are good exposures of red argillite, and the occasional outcrops higher up are of red flinty sandstone and argillite.

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* Geol. Surv. Rep. for 1877-78, p. 20 F.

In Murray's Brook, below the Triassic, are quartz-veined red quartzite and argillite and whitish compact quartzite. Similar rocks, sometimes full of fossil plants, extend south to Harmony and across to Henry Christie's Millbrook, the land being very rocky.

Truro.

The rocks of the lower part of Victoria Park Brook, of Truro, are reddish or purple crumbly shales which might represent the upper beds of Tracadie and Rocky Bay*. Higher up at a fall, they are succeeded by fine grit, sandstone or quartzite, whitish and like that of Grand River, part of the surrounding country being also like the Grand River barrens. The bands of sandstone interstratified with the shales are very coherent and contain markings of plants. The brook is rocky and steep and presents views of extreme beauty.

Fossil plants.

Clifford's Brook.

Passing to the tributaries of the north side of Salmon River, the first rocks from beneath the Triassic in Clifford's Brook are red crumbly argillites, followed by reddish-grey, fine, striped sandstones and coarse grit, with streaks of green, containing a little pyrolusite in the joints which has led to the cutting of many pits and trenches in search of that mineral. Above the road, at one of these openings, pieces of Carboniferous limestone are found in the drift, and not far up stream this rock forms a cliff. In McKenzie Brook, above Philip Archibald's, the red argillites first seen are succeeded by dark grey argillites and rusty-weathering sandstones or quartzites probably of the Riversdale series. A little lower down, red argillites are found in contact with green marls, which may be associated with the gypsum of the quarry. Down stream from the fork to Salmon River are outcrops of grey and reddish, sometimes bright red, mottled, greenish, cream-coloured and reddish sandstones and shales, with a two-foot band of concretionary limestone conglomerate. Plates and veins of manganese ore occur in the planes of bedding and jointing. On the railway between the mouth of this brook and Valley, the quartzites are curiously channelled in the direction of the joints which are at right angles to the dip; they belong, of course, to the higher series of Union.

Manganese ore.

Carboniferous outliers.

Manganese mines.

In the west branch of Halfmoon Hill Brook, which follows the Telegraph road for some distance, are reddish, purplish, greenish and grey, striped and banded flags and shales, with layers of flinty, micaceous sandstone, containing veins and large blotches of pyrolusite, just as the hematite and specular iron ores occur in the Guysboro' quartzites. Many pits have been opened on these deposits which are unconformably covered down stream by Triassic rocks.

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*Geol. Surv. Reports for 1879-80, p. 39 F; and An. Rep. Geol. Surv., vol. II., 1886, p. 65 P.

**Triassic and Carboniferous rocks.**

The purple and red argillites, with greenish and grey spots, of the upper part of Farnham's Millbrook will be described with the Carboniferous limestone at their unconformable contacts.

On the Jollytown road for 472 paces north of the Telegraph road, obscure traces of greenish perhaps Carboniferous sandstone are met with. In the brook a short distance further, pieces of grey, flinty, flaggy sandstone are succeeded down stream by red argillite and quartzite, overlaid at one point by Carboniferous limestone. Further out, the road crosses grey and reddish soft sandstone and shales, comparatively unaltered, very like Carboniferous, but also like certain Devonian rocks of the North and Salmon Rivers, not well exposed, and associated with flinty sandstone and with dark bluish-grey or blackish shales, resembling rocks of the Three Mile Lake near Lochaber and of the bridge on Salmon River near Riversdale.

**Rocks between East and West Rivers of Pictou.**

These exposures connect the rocks of Salmon River with those of the south branch of North River. But before describing the latter, we may again turn eastward to the great block of Devonian rocks lying north of the railway between the East River of Pictou and the head of the West River, which consists chiefly of the red rocks of Union and of the ferriferous intermediate series. They are affected even more than the other series by faults and flexures, the minute structure being in many cases still obscure.

**Devonian of the Pictou coalfield.**

The extension of these rocks from the Middle River nearly to the East River of Pictou on the north side of Blackwood's Brook, as shown on the map of the Pictou coalfield by Logan and Hartley, seems to be a mistake, no outcrops being found and the drift pointing rather to the presence of sandstone, like that of Fraser Ogg's quarry and of the New Glasgow conglomerate.

**Dyke near Fishpools.**

**Veins.**

On the other hand, the red, flinty, veined slates of Fishpools and the rocks immediately south of the south fault in the East River are apparently Devonian rather than Millstone grit; and, as was pointed out by Mr. Poole, superintendent of the Acadia Coal Company, they are cut on the left bank by a small dyke of diorite, five yards wide, containing spots of quartz. The adjacent strata, which resemble those of Rocklin on the Middle River, also contain veins of quartz, calcspar and ankerite. The red rocks on the right bank of the river, a short distance above the mouth of the McKay Brook, are, beyond question, Devonian. In the most northerly of the three branches of this brook, the rocks are of the flinty series, with a possible exception of the highest outcrop of flaggy red sandstone which seems to belong to the Millstone grit. The fields indicate Millstone grit between this and the middle branch and also the outcrops near its head where it turns into the woods. Thence to the head of the third or southerly branch, the debris is of flaggy Millstone grit, down to an outcrop about 150 yards from the road, which seems to belong to the lower series. Good outcrops of rocks, often vertical, extend down stream from the road to the river. In a very small brook on the left bank of the river is an outcrop of greenish and reddish flinty sandstone like that seen at the south fault. It has, however, a vein of quartz one-quarter of an inch in thickness. In the river bank immediately above the mouth of the brook are bright red slaty rocks, like those of Fishpools, passing apparently insensibly into the red rocks of Rocklin and the south fault. Fifty-five yards above the brook is the dyke mentioned above, which may account for the greater alteration of the rocks hereabout. At a short distance higher they are greatly faulted and twisted, but are soon succeeded by the limestone of the Riverton quarry, in the neighbourhood of which a little brook crossing the railway shows red, flinty sandstone and argillite so cleaved as to make it difficult to obtain the dip.

McGregor's Mountain.

The outcrops in the brook near D. J. McDonald's at the west end of McGregor's Mountain are probably of the same series; while below the road they are undoubtedly of Millstone grit. On the hill are knobs of trap, north of which is a conglomerate and on the south-west escarpment is a large quantity of red and green slate, veined, and like that of the East River.

Cameron Brook.

Another tributary of the East River, Cameron (Meadows) Brook, exposes rocks, some of which perhaps belong to the lower group. They comprise red, greenish and bluish-grey argillite, dark bluish-grey shales, sometimes siliceous and quartzose, sometimes brecciated, containing crystals of pyrite, druses of calcspar and markings of graphitized plants, with bands of massive quartzose grit and greenish and yellowish siliceous slate, resembling certain rocks of Alma and Glengarry, and altered by the igneous rocks of the neighbourhood. The red sandstones on the railway, a short distance above the crossing of the main branch of this brook, are probably Millstone grit, the vertical dip of which may indicate a great fault. A short distance further west, in the brook immediately below the meadows, they are succeeded by red rocks apparently of the Union series, with two bands of shaly, calcareous argillite, six feet in thickness, and with layers of grey sandstone or quartzite, like that of Grand River. The shales are coherent and slaty, the sandstones flinty, ringing and rubbly; they are associated with bluish-grey and greenish-grey slates, similar to those found north-east of Glengarry. On the road which crosses the railway west of the marsh, there is

Fault near Hopewell.

no question of the Devonian age of the purple slates; to the north of this road are many blocks of Devonian rock, with others of syenite; and rocks similar to those of Watervale extend to the Marshdale cross-roads. On the road to the left from the cross-roads, slaty, Devonian sandstones and argillites, greenish and grey, purple and reddish, extending to the road along the Middle River, are well exposed in a large brook not far above Concord Mills. On the road up the river to Glengarry the debris is very like that seen on the railway and on other roads north of it.

Marshdale.

Lorne.

Blocks of purplish argillite and striped diorite on the railway east of Lorne probably indicate the rocks of Glengarry and Big Brook; and a rusty-weathering limestone, resembling that associated with a black shale of Big Brook, is found with whitish sandstone, perhaps that dug with the black shale at Jesse Grant's.

The green shales below McDonald's road near Lorne are probably the equivalent of those of Middle River; the black graphitic rock below is perhaps the black shale, with lenticular limestone masses, of Middle River and Balfour Brook. The flinty, rusty-weathering sandstone and grey and greenish flags, below the limestone and dark shale, belong probably also to the Devonian. The limestones of this formation when not well exposed are apt to be confounded with the Carboniferous. Gordon's quarry is on one of them. Near the road to the quarry are greenish and grey, rusty-weathering, flinty, siliceous, slaty argillites, like certain strata found in the neighbourhood of Marshdale cemetery associated with red argillites and sandstone.

Limestone quarry at Glengarry.

Contact with Carboniferous at Lorne and Elgin.

From Lorne siding on the road towards Lorne the debris indicates Devonian slates and igneous rocks; but on approaching the post office these give place to the plaster pits of the Carboniferous. On the road to Elgin, reddish and bluish slates occur; and the red rocks in the little brook a quarter of a mile north of the Elgin post office are perhaps Devonian; but the reddish and grey micaceous flags of the larger brook, half a mile further along the road, are undoubtedly Carboniferous, and in the river, below the mouth of this brook, are fine cliffs of red and grey Carboniferous sandstone and shale which continue to Hopewell.

Middle River.

No finer exposures are anywhere to be found than those of the various branches of the Middle River, and, judging by the variable dip, there must be many displacements of these strata. In the west branch, above the fork below Glengarry, the bluish-grey sandstone and slate first seen are not more altered than most of the rocks of Riversdale, and the greenish-grey sandstone greatly resembles the rubbly sandstone of the barrens. Immediately below the fork, dirty greenish-grey, rubbly sandstone and argillite, lying nearly horizontal and, lower down stream, dipping southerly, resemble the rocks of Riversdale; the soil on the banks being rusty like that of West River and Riversdale. The cliffs on the left bank, lower down, are of dirty greenish-grey, crumbly argillite and of soft, flaggy, micaceous, quartz-veined sandstone, very like the rocks of Campbell's siding, the argillite containing small nodules of ironstone. Underlying these, still dipping down stream, are reddish, slaty argillites like those of Campbell's siding, and also remarkably like rocks seen in Salmon River. On the right bank, at Murray's mill-pond at Concord mills, are red rocks like those of Union, with greenish-grey bands, dipping north-westerly at a high angle, extending for some distance below the dam and being succeeded, in nearly vertical bedding, by alternations of light steel-grey, dark greenish and bluish-grey, flinty, micaceous, compact argillite and sandstone, cut by small veins of quartz, with a calcareous band, one foot thick, associated with the prevailing reddish argillite which is slaty or prismatic, breaking into large scaly pieces or into knife-and-needle-shaped fragments. The sandstones are spotted with minute cubes of pyrite and interstratified with darker papery shales, with lenticular masses of pyritous, rusty-weathering limestone. Some of the more arenaceous bands are full of reticulations and blotches of whitish quartz. Similar rocks extend in almost unbroken cliffs and reefs, the whole section being very much like that between Union and Riversdale, and some of the quartzites strikingly like those of the fork of the Black and Salmon Rivers.

Ironstone.

Concord mills.

Quartz veins.

Limestone.

The slates at the head of Rocklin mill-pond are greatly altered, as well as those off the brook coming into the pond, among which a pit has been dug in search of copper. The dip is southerly as far as the mouth of Balfour Brook; and up stream in this brook is a descending sequence of the red rocks of Union, jointed into blocks, the argillites greatly predominating, with a low angle of dip. The blackish shales higher up are, perhaps, those of the fork of the river; they are papery and include lenticular masses of greenish-grey limestone, slaty, polished and graphitic. Above the bridge on the river road are light sea-green nacreous slates, cut by veins of ankerite and quartz, sometimes one inch thick, interstratified with whitish-weathering quartzite with rusty patches; overlying are purplish, rubbly, flinty sandstone or quartzite, and up stream is a mass of greenish-grey, fine, pyritous limestone, succeeded by rusty-weathering, pebbly grit, containing specular iron ore, and by compact quartzites like those of Guysboro'. Higher up the rocks form a gorge. The dip is generally obscure.

Rocklin.

Black shales.

Iron ore

**Whitehill.** On the road from Hopewell to Whitehill school, the reddish and grey, flaggy, wavy sandstones are probably Millstone grit; but, on the steep road north-westward from the school, flinty, friable Devonian argillites are immediately in place. On the road south from the school, blocks of flaggy Carboniferous sandstone are in one place seen, but for the most part, for two miles, as far as the road on the left, the debris seems to indicate Devonian. On the road to the left are quartzites and trap, succeeded by Carboniferous rocks, which extend to Hopewell. Up stream in the brook, not far west of Whitehill school, are outcrops of grey and red, rubbly, coherent rocks, with veins of ankerite and films of specular iron in the joints. Below the road in this brook, similar coherent rocks, often rusty or cream-coloured, full of ferruginous matter, and very like strata of the Londonderry iron ore series, are fairly well exposed down to the house in a clearing, where a high hill is on the right and low land on the left. At the foot of the clearing, not far from the house, the brook exposes rocks of a totally different character—red, soft sandstones, dipping at a low but variable angle, perhaps Carboniferous, A short distance lower, however, reddish and dark grey, rubbly, veined, ferruginous strata are again in place and are well seen at the bridge below on the river road.

**New Larig.** On the road north-east from New Larig post office, purple Devonian slates are interstratified with greenish and grey varieties*.

**Millbrook.** Upper Devonian rocks are well exposed at and below the picturesque thirty-feet fall at Thomas Fraser's mill at Millbrook. They consist of grey, rusty-weathering, greenish, sometimes silvery, and reddish, flinty, splintery sandstone and slate, which are also found in the roads and brooks of the neighbourhood, spotted with specular iron, pyrite and ankerite, like the rocks containing specular iron at Guysboro' and West River. Certain beds contain fossil plants. Succeeding the quartzites and slates of the falls down stream, are reddish argillites with greenish bands and blotches, and hard layers of micaceous, fine sandstone, the argillites crumbling into pieces of a regular shape as large as marbles. Lower down these are associated with graphitic slate, containing papery layers and lenticular patches of wrinkled graphitic limestones, like that of Balfour Brook. Below the bridge, at Kerr's old factory, are ribbanded shales with a high and variable dip, they include grey soft beds of argillaceous shale and sandstone, with many carbonized plants, and some of the associated rocks are veined with ankerite and contain much yellow iron oxide in the joints. The road from this point up the Middle

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* Canadian Naturalist, vol. IX., 1880.

River is probably all underlaid by Devonian flinty rocks. From the end of the Millbrook road and down along the river road, the land is flat and cultivated, and shows no rock to the road across Middle River at Union Centre. Argillaceous debris is still found, but perhaps only as drift. In front of Mr. Duncan McDonald's house are several blocks of grey Carboniferous sandstone and in the road beyond, near the next house, are many pieces of red Carboniferous sandstone. On the road from the bridge to the Pleasant Valley cemetery no rocks are seen, but on the back road the debris is Devonian.

Copper ore.

In the little brook which enters Middle River opposite the Millbrook, greenish and grey sandstones lie at a variable angle. Below the bridge they contain traces of copper ore. Higher up are red rocks like those just described. Perhaps at or near this brook is the passage of a great north-and-south fault.

Hugh's Brook.

The first rocks seen in Hugh's Brook above the Middle River roads, are, perhaps, Carboniferous. Those found a little higher resemble the red rocks of Union, which are also indicated by the blocks in this neighbourhood and towards Pleasant Valley. The rocks of Hugh's Brook, from the school at Pleasant Valley down stream, are singularly rubbly, notwithstanding their great lithological resemblance to Carboniferous. The Devonian metamorphic aspect is, perhaps, best seen at a little brook from the left, below a bridge on a farm road, where the dark argillaceous shales with calcareous bands strongly resemble a rock on the railway between Hopewell and Lorne, and also that of Balfour Brook and Millbrook.

Balfour Brook.

In Middle River, below Balfour Brook, is a descending sequence of red flags and argillites, underlaid by light grey and greenish-grey, flaggy sandstone, all of which contain broken plants. The sandstone is about twenty feet thick and is underlaid by five feet of greenish shale, succeeded by red rocks, one fine, flinty bed of which contains spathic iron in the joints. The grey sandstone is on both sides of the river and seems to form an anticlinal to it. It is very flinty and, like the rocks of West River, contains pipes of coal. Lower down are reddish, coherent rocks, almost certainly the same as those above Rocklin and including a band of red quartzite. Then come the nearly vertical, reddish-grey and greenish, rusty, broken, flinty sandstone and argillite beneath the church, veined with ankerite and glistening with quartz. The red beds greatly predominate. The grey and greenish beds include pipes of coal. These rocks are exposed to a little below the bridge, the grey sandstone being perhaps the same all along, the strike carrying it down the river. They are still seen at a brook from the right opposite Millbrook, where a sparkling, fine sandstone, breaking into pieces of irregular size and shape, shows none of the smooth-bedded, flaggy character of Carboniferous sandstone. Below this brook rocks are concealed for some distance, and red, greenish-grey and grey sandstone and argillite are next seen, while immediately below are grey sandstones of flaggy, coarse variety, full of broken plants, less altered than those above described and perhaps Millstone grit, the Carboniferous limestone being apparently all cut out on the river by a great fault.

Brown's Brook.

At the mill on Brown's Brook, not far east of Pleasant Valley road, are outcrops of greyish, dark-grey, greenish-grey and reddish shales and sandstones, coherent, rubbly, nearly vertical and like the rocks north of Glengarry. Eastward from the mill to the main road the grey soil perhaps indicates Devonian, although at the bridge and in the brook up to the mill the New Glasgow conglomerate is in place. Devonian debris is very abundant on the road to the south from the bridge. On the main road, north as far as the carpenter's shop, the soil is also grey, but outcrops of the Permian conglomerate are in the brook on the right. To the westward, however, on the Truro road, 744 yards before coming to the watering brook east of Salem church, greenish Devonian rock, precisely like that of McCulloch's Brook and the railway, is in place in the road cuttings. Thence the boundary seems to follow the road to the fork of the road to Limerock, the conglomerate of Greenhill lying to the north. Up stream the watering brook for half a mile from the road shows only blocks of grey and greenish-grey Devonian rock with films of specular iron. From this point north-westward to the road above the church, similar debris is found in the fields, and pits have been sunk in search of iron ore.

Greenhill.

McCulloch's Brook.

The Devonian rocks of McCulloch's (Bear) Brook, Alma and Waters' Hill have been described by Sir J. W. Dawson*, Dr. Honeyman†, and Mr. Hartley, but the latter has included in his description small areas of the New Glasgow conglomerate, which lie unconformably upon them§. In McCulloch's Brook they underlie the Permian and Carboniferous, and comprise greenish-grey and red, mottled, rubbly slate and micaceous sandstone, with patches of conglomerate which contain large pebbles of a quartzite, like that of Guysboro'. With these are associated

Newer rocks.

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* Acadian Geol., p. 502, and Supplement, pp. 48-70.

† Trans. N.S. Inst. Sc., vol. III., p. 141.

§ Geological Survey Report for 1866-69, p. 58, l. 4.

greenish soft rocks and light grey micaceous quartzites, full of quartz-veins. The series resembles certain rocks of Silvey Brook and of Elgin. In the lower part of the brook the outcrops are interrupted by overlaps of the New Glasgow conglomerate. From these rocks in 1866 Dawson obtained "stipes of ferns, apparently of two species; a *Pinnularia* and branching stems much resembling those of *Psilophyton*, a characteristic Devonian genus; also fragments of carbonized and pyritized wood, but not sufficiently perfect to show structure." The broken conglomerate and bluish-grey slaty rocks of the railway cuttings west of this brook, and the rocks which underlie the New Glasgow conglomerate above the bridge at Alma are also of this age. They consist of greenish-grey fine breccia or conglomerate and light grey, micaceous, compact, flinty sandstone, resembling in their brecciated and rubbly character Cambro-Silurian rocks; but the argillaceous layers are soft and earthy.

Fossil plants.

The crystalline, non-fossiliferous limestone of Waters' Hill is a shaly and thick-bedded, greenish, compact, splintery and ringing variety, full of veins of calcspar. It is underlaid by greenish, rubbly, splintery slate, cut by blotches of ankerite; and obscure deposits of iron ore have been found in the immediate vicinity.

Limestone of Waters' Hill.

Iron ore.

Exposures of Devonian rock, perhaps equally interesting, are exposed in the West River of Pictou, between the railway and Saltsprings. The debris seen on the road down the west side of the river indicates, as already stated, rocks similar to those of the railway west of the station. The first outcrops in the river, a short distance above Watervale, are grey and greenish-grey rubbly argillites and siliceous sandstones, blotched with quartz and with joints full of films of specular iron, somewhat pearly but not graphitic, with veins of rusty-weathering ankerite and specks of pyrite. These are associated with layers of green and reddish more evenly bedded rocks, with graphitic streaks, all very flinty and compact, and including patches of conglomerate; also with ripple-marked flags, sometimes dark and graphitic, resembling the rocks of Guysboro'. Immediately above the Watervale bridge, are cliffs of bluish and greenish-grey, massive, siliceous and argillaceous slates, dark grey graphitic flags containing a few veins of quartz, and joints glistening with specular iron. Among them are patches of conglomerate or breccia and several purplish layers; the green slates are finely ribbanded; the quartz veins contain also spathic materials. Succeeding these rocks some distance down stream are greenish, soft, pearly slates, like those of Silvey Brook, with specular iron in the joints and reticulating veins. Some of the

West River.

Iron ore.

Watervale.

Fossil plants.

layers show *Cordaites*, *Calamites* and other land plants. Lower down the proportion of red beds is larger, and a fine gorge shows nearly unbroken outcrops of banded and mottled red, green and grey rocks, often veined with quartz, sometimes calcareous, and with limestone nodules. Many impressions of trees occur in the sandstones, and of broken plants in the dark shales. At the high picturesque bridge above Saltsprings, rocks are still exposed, being here bright green, bottle-green and grey, with red layers, and a rusty-weathering, wrinkled, slaty, impure, crystalline limestone, ten feet thick. At a fault a short distance down stream, soft Permian rocks succeed these strata, but they reappear in cliffs on the right bank, where they contain patches of conglomerate and of bluish-grey flinty breccia. Still lower down are cliffs of greenish-grey, thick-bedded or massive Devonian quartzite.

Crystalline limestone.

Watervale Brook.

Carboniferous and Devonian.

In Watervale Brook, for a great distance above the red, purple and greenish slates and quartzites of the mill-dam at the river road, the ground is covered with blocks of bright red and grey conglomerate, grit and soft sandstone, probably Carboniferous strata resembling those of the West River of St. Mary's, and of Galant River, Margaree. On the north side of the brook, however, is a hill upon which are exposures of purple, grey and greenish Devonian slates, and high up the brook are good outcrops of Devonian rock. On the road from the Telegraph road to Watervale all the rocks are Devonian as far as the crossing of the first branch of Watervale Brook, where the conglomerates begin. On the road from the head of this brook, at McKay's, back to the railway, Devonian rocks again appear, but the greater part of the track is occupied, as already stated, by Carboniferous sandstone, grit and conglomerate. At the head of Watervale Brook, on the road to McKay's, and elsewhere in the neighbourhood, are good outcrops of light grey, greenish and whitish slates and quartzites.

In the brook from the west below Watervale exposures of broken rocks above the road, perhaps indicate a fault. The rocks on the north-east side of the vertical dip are grey sandstones and dark shale or slate, like those near Riversdale. Higher up, the steep dipping rocks do not again appear, but to the northward is a glen supposed to indicate newer unconformable rocks.

Saltsprings.

In the little brook which enters the West River from the eastward at the forge at the end of the suspension foot-bridge opposite Saltsprings, there are exposed greenish-grey, rusty-weathering, flinty Devonian rocks, with whitish calcareous bands, layers of rusty-weathering sandstone, full of blotches of specular iron and ankerite, associated with lilac and red rocks. In the large brook to the eastward, the outcrops show a large preponderance of red. They are associated with wrinkled, brecciated, very pyritous limestone, veined and blotched with calcspar, underlaid by a considerable thickness of whitish sandstone like that of the suspension bridge. The limestone passes into, or is intimately associated with, black shale, veined with calcspar and quartz, and full of pyrite. These rocks are overlaid by the soft sandstone and conglomerate of the river. The limestones here and in the river are no doubt those referred to by Sir J. W. Dawson*, as "altered Carboniferous rocks." But they differ from and are unconformably beneath the unaltered Carboniferous limestone of Limerock further down the river. Limestones.

The large blocks of purplish, flinty conglomerate on the road between Lovat and Millbrook are perhaps Devonian. Between Millbrook and Limerock, purple Devonian slates are cut by igneous rocks; they include a greenish breccia, like that of McCulloch's Brook, and are overlaid with soft sandstone, probably Permian. Other brooks of this region present good outcrops, but need not be referred to as they are indicated on the map. Dykes.

South-west of Millsville, among the felsites and breccias of Mount Dalhousie are red and green argillite, probably of Devonian age. Mount Dalhousie.

In this connection the doubtful red rocks of Waugh River and the vicinity may be described as probably of this age. Near the head of Nabiscump Brook they are found, near the margin of the Silurian areas, altered by dykes of felsite and diorite, and comprise flinty red argillite, quartzite, grit and conglomerate. South of this brook are reddish and purplish flinty, micaceous, rubbly sandstones, spotted with white and green, in part calcareous, and massive, with traces of hematite, very like the red rocks of Union, and associated with bluish-grey massive argillite, blotched with quartz. Waugh River. Dykes.

On the road down along Waugh River, below Earltown, are great blocks of very flinty conglomerate, like that of Arichat or Barney's River, in which are found traces of hematite. Where the river crosses the road, outcrops both of sedimentary and dioritic rocks are present, while in several brooks of the neighbourhood there are red flinty rocks, which resemble the Devonian lithologically. In a little brook from the north, which crosses the road below Earltown Falls, reddish, very rubbly argillites, with polished joints, full of calcspar and hematite, are found above the road, associated with layers of reddish, micaceous, nearly compact, somewhat flinty sandstone, showing a few *Psilophyton*-like markings of Fossil plants

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* Acadian Geology, p. 315.

plants. They most closely resemble the red rocks of Union, and probably include a very flinty conglomerate of the neighbourhood. In other brooks this is calcareous, blotched with green and veined with quartz and calcspar.

Not far above the bridge, on a road to Baillie's, is an outcrop of dark greenish-grey, soft trappean and dioritic rock, followed by reddish, fine and somewhat flinty argillaceous sandstone, interstratified with red, soft, crumbly argillite, and with pebbly patches. The shales hold many greenish and grey nodules of limestone, smaller than a hen's egg, also one greenish nodule of argillaceous rock, nine inches thick. Then in cascades are seen alternations of reddish-grey, flinty Arichat conglomerate, composed of pebbles of felsites and quartzites. Similar outcrops occur in other streams of the neighbourhood about Ferguson's Brook.

Limestone nodules.

In a branch of McDonald Brook, a tributary of Waugh River, blocks of diorite or trap are found not far above the mouth, succeeded up stream by outcrops of light grey, flinty, fine sandstone, reddish sandstone, and grey, soft, argillaceous flags, used locally for whetstones. But the greater part of this district is underlaid by dark grey, massive, fine diorite.

Whetstones.

Cobequid Bay North River.

Devonian rocks are well exposed in all the streams flowing into Cobequid Bay from the north. Of these the first is North River, in all the branches of which they are met with. In the south branch of North River both the upper and lower rocks are present and have in most places been indicated on the map. The contact of the iron ore belt of these rocks with the overlying conglomerate of Carboniferous age is well seen in the little brooks which flow into the North River from McKenzie settlement; the junctions appear nearly all to be faults. On the road from this settlement to the Earltown road, the debris indicates Devonian rocks, and the Carboniferous seem to be cut off in this direction. On the track through the woods eastward to the south branch of North River, the blocks, as far as the crossing of this river in a hay-marsh or meadow, are of reddish-grey, somewhat flinty sandstone, often coarse and flaggy, possibly Carboniferous, but more probably similar to the coarse rocks found greatly altered by the syenite in the branch above John Munro's. On the east side of the meadow a great quantity of rubbly quartzite debris, chiefly red, and containing traces of specular iron, points to the extension of these rocks in this direction; and at the edge of the clearing, near the site of an old portable mill, limonite has been dug in considerable quantity from red and cream-coloured slates. Down stream from this mill are outcrops of grey, rusty-weathering and red or

Iron mine.

purple, coherent, slaty argillite, full of threads of limonite, and with films of red hematite in the joints, interstratified with bands of fine, micaceous, flinty sandstone or quartzite. Rocks less altered succeed down stream; then none are seen down to the branch from a meadow and large lake, and for nearly half a mile below this fork; then grey and reddish-grey, fine, flinty sandstone is found, the river passing through a barren waste, like that near Landsburg's, on the West River. Few rocks are, however, seen to Mingo's intervale where they appear to be chiefly of the lower group.

Contact of Triassic.

Reddish crumbly shales with bands of flinty sandstone come from beneath the Triassic on the right bank of North River, seventy-seven yards below the iron bridge, the Triassic lying at a very low angle; and in the brook immediately to westward are outcrops of grey slaty argillite and of reddish and grey, somewhat flinty, flaggy sandstone and rusty-weathering shale. On the opposite side of the river the contact is again seen in Smith Brook, the boundary between the Triassic and the reddish, flinty, sandy shales following the edge of the intervale for some distance.

Coaly shale and limestone.

On the south side of, and underlying the conglomerate and grit in the North River near Cranberry Brook, is a great thickness of red rocks of this series in descending order, the dip at the top being about 61°, but generally much lower. If there is no fault here, the rocks exposed must represent a thickness of 4,745 feet, as computed from the dips. They consist of reddish-grey and grey, flinty, micaceous flags and quartzites, the grey beds being full of broken plants, and including a layer of flinty nut-conglomerate, of mottled red and green crumbly argillite. The sandstone is fine, sparkling with grains of quartz; it includes patches of grey and greenish limestone conglomerate, streaks of black carbonaceous shale, and lenticular layers of greenish argillaceous shale, and of light grey, rubbly, wavy sandstone, with *Calamites*. The dip to this point has been up stream. Now it is reversed to 172° $<$ 67° perhaps at a fault, and there is a fine exposure of grey wrinkled shale and thick-bedded limestone, probably fifty feet thick, full of calcspar veins. On the north side this stands nearly vertically against red argillite, succeeded by grey flinty sandstone or quartzite. On the south side the rocks are concealed for some distance. It is like the limestone found altered among the syenite and diorite above McCallum settlement. Below the bridge, on the post-road, the rocks are dark bluish-grey with reddish bands; evenly-bedded shales with limestone layers and nodules, perhaps belonging chiefly to the lower group; and on the road to the westward, perhaps underlying the red shales, is a coal seam which has been worked in a shaft*. At the limestone the rocks dip down stream at a very high angle, but a short distance from it they again dip up stream, and the grey rocks would thus underlie the red, as at Riversdale and Salmon River. In Canoe Brook, the red rocks are also well exposed, as shown on the map.

Upper North River.

In the river, where it follows the Earltown road, between Upper North River and Nuttby, the flinty rocks succeed the conglomerate and Carboniferous grit about 240 yards above the bridge on the road to the McKenzie settlement. Here they are light grey, flinty, sparkling sandstone or quartzite, with reddish bands, greatly altered, followed by greenish, more argillaceous rocks, flinty and porcellanous, full of reticulations of quartz. Then, at a little cascade, greenish sandstone is seen within four feet of a granular chloritic diorite of many shades of dark green, traversed by veins of epidote, and mixed with bright red syenite. The slaty rocks are half a mile wide; then comes half a mile of coarse syenite and diorite, then sedimentary rocks mixed with igneous, the former consisting of greenish-grey, flinty, nut-and-egg conglomerate, with fine, grey, rusty-weathering sandstone, succeeded by black shales with layers of bluish-grey calcareous rock, sometimes a fair limestone, and in one place eighteen inches thick. The slates show graphitized markings of plants, and perhaps belong to the lower group. Higher up are flinty bands of grey grit and of greenish and dark porcellanite, the prevailing rocks being dark shales and flags of lighter colour, often greatly contorted and in contact with greenish fine diorite, full of grains and threads of quartz. Similar rocks occupy a great breadth on the road towards Earltown. In a brook near the top of the hill they are flaggy and quartz-veined, but in the first brook flowing the other way, trap and diorite prevail, although among them are still found red flinty rocks. On the old Earltown road red syenite is the country rock for a great part of the distance from McKenzie settlement to the junction of the new road at the top of the hill, altered red argillite being, however, found three-quarters of a mile from that road; and from the junction to Nuttby post office apparently including masses of diorite. On the road towards New Annan at Kavanagh's mills, about 200 yards beyond the house, half a mile from the fork of the roads, is a mass of pinkish porphyritic felsite, but almost immediately again come in dark slates, Silurian or Devonian. Slates extend for some distance on this road, as far as the last house at the head of the brook, beyond

Contact with igneous rocks.

Earltown.

New Annan.

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* Geol. Surv., Ann. Rep., Vol. I, 1885, Part E, p. 47.

which rusty-weathering porphyritic felsite, dark diorite and black and grey trap extend to Kavanagh's mills.

Carboniferous rocks.

McCallum Settlement.

Igneous rocks cutting limestone.

In the west branch of North River, above the bridge at the Presbyterian church on the Tatamagouche road, blackish shales are succeeded by reddish and greenish sandstone and shale, with a few bands of ironstone, again succeeded by greenish and grey and reddish argillaceous shale, with layers of compact, flinty sandstone or quartzite. At one point a light grey sandstone includes a patch of pea-and-nut conglomerate and of limestone conglomerate, while higher up a dark grey underclay is interstratified with the greenish shales and with coarse grey sandstone, full of small pebbles of white quartz. Among these rocks are many carbonized plants. Then come rusty, coarse sandstones, with a coaly band, fifteen feet thick, consisting for the most part of carbonaceous shale, with thin layers of shaly coal and many irregular layers and nodules of ironstone. An upright tree one foot in diameter is found in connection with the coal seam. Then come coarse and fine sandstones, with pebbly patches, dark shale and greenish-grey shale. Some of these coarse beds may belong to the higher conglomerate series, brought in by faults or unconformity. Above a band of newer conglomerate come grey flinty sandstones and shales like those of Riversdale. Then for some distance below the mill at McCallum Settlement is a coarse reddish conglomerate containing pebbles of the Devonian and igneous rocks. But above the road at this settlement these higher rocks are succeeded by the diorites and reddish-grey, rubbly, flinty quartzite and altered slates, which here include a limestone, the contact of which with the igneous rocks is described elsewhere. The quartzites in thick beds dip $123^\circ < 85^\circ$ near the contact. After more than a mile of diorite and syenite in the river comes another patch of altered sedimentary rocks, more than half a mile wide, immediately above a saw-mill. These consist of light pea-green, bottle-green and dark bluish-grey nut-and-egg conglomerate, with bands of fine grit and sandstone, patches of shale like that of Baxter Brook, and compact quartzo-felspathic sandstone. The pebbles are of porphyritic felsite, quartz and other rocks, but none of the syenite and diorite with which they are in contact. Then follow dark grey, flinty quartzite and conglomerate, in colour and texture very like that of Cape George, but also reddish, with pebbles of red syenite, but for the most part of altered quartzite. These rocks have blotches of rusty-weathering limestone and one bed four feet thick of whitish-grey crystalline limestone or dolomite, succeeded immediately by red slate and conglomerate with many veins of crystalline quartz, which cut both pebbles and matrix. Then a greenish, slaty, fine sandstone shows black graphitized markings of plants; and dark grey slaty shales higher up, associated with flinty grit and sandstone, are full of markings of minute plants and of broad *Cordaites*. Some of the shales are fit for whetstones. The grit resembles that seen lower down near the coal, but is of course much more altered. Dark slates and rusty calcareous flags are again cut off by light greenish trappean rocks, granular quartz-felsite, fragmental and porphyritic, mixed with greenish diorite and small blotches of red syenite; but higher up, immediately below the bridge where this stream crosses the Tatamagouche road, dark bluish-grey slates are again present.

Fossil plants near igneous rocks.

The rocks, which begin almost immediately below the little branch from the lake on the west side below McCallum settlement, are probably those of Union. The grey sandstones and grits underlying are probably equivalent to those of the middle branch. Below them is a band of rusty conglomerate, loose in texture, like that of McCallum's mill, composed of felsitic and quartzose rocks; this is Carboniferous and is underlaid at a little brook from the right, by dark shales containing coaly matter, and by more rusty grit and conglomerate, the river falling over rocky cascades. Then follow grits to a brook from the right, below which alternations of grit and black shale dip up stream. Then light grey, flinty, syenitic grit, with layers of black shale, occur on a roll. The outcrops are far apart. Lower down is an extraordinary thickness of grey, fine, flinty sandstone and slaty flags.

Coalmine Brook.

In Coalmine Brook, reddish, very flinty, micaceous sandstone and rusty-grey, rubbly, compact rocks, greatly metamorphosed, come against the coal-bearing rocks by a fault. The red rocks predominate and have green spots, with specular iron in the joints, like the rocks of the manganese mines near Valley. Higher up, are dark slates in contact with light grey and greenish, granular, syenitic rock; and wedges of light greenish-grey trap penetrate the argillite. Above a mass of syenite and diorite, reddish, micaceous, flinty argillite is again in place at the head of the brook near the old Tatamagouche road. On this old road among the igneous rocks are many outcrops of altered sedimentary strata shown on the map.

Dykes.

Belmont.

In Beaver Brook above Belmont, are only a few obscure outcrops of grey shale, flaggy, flinty sandstone and other rocks perhaps of this group. In the west branch of Baird Brook are reddish, greenish and grey, mottled, somewhat crumbly shales, with greatly contorted dip.

A large proportion of the rocks of Chiganois and Folly Rivers and of the streams of East Folly Mountain belong to this group, but they are so intermixed with the others by frequent foldings that it has been found more convenient to describe them with these latter. And the same rule will be followed with regard to such rocks of the lower group as occupy small areas among the red rocks in the country west of Folly River.

Folly Lake.

About 330 yards north of the road-crossing below the foot of Folly Lake, a large brook from the westward crosses the Intercolonial railway, and up it a logging sluice has been laid for about one mile and a half to a mill. At this mill are reddish and greenish, flinty, banded, altered rocks, followed down stream by light green and dark bluish-grey, flinty, compact slates in contact with a massive dark magnetic diorite. In falls and rapids further down there are flinty slates, almost gneissic, with included irregular masses of diorite in the bedding, the gneissic rocks carrying veins and blotches of quartz and epidote; and light-coloured and rusty quartzites or greatly altered fine sandstones and schistose argillites, intermixed with epidotic diorite and compact quartz-felsite, extend to the cascade, about thirty-five feet high, immediately above the bridge on the railway, at which diorite, veined with syenite, is well exposed.

Great Village River.

In the gorge of the east branch of Great Village River below the mouth of the tributary mentioned on page 40, are cliffs of massive reddish syenite, quartz-felsite and diorite, among which lie greenish more or less schistose rocks, chloritic, dioritic and quartzose, dipping 167° $<$ 80°, with small veins, layers and blotches of quartz; succeeded a few yards down stream by well-layered, flinty quartzites and splintery slates with the same dip, coherent and strongly bound together, interrupted again by greenish calcareous, chloritic diorite, followed among the falls of a wild gorge by reddish and grey, compact, syenitic rock. Below the foot of this gorge, about 750 yards above the dam for the Londonderry company's sluice, the igneous rocks no longer predominate, but are replaced by those of the iron ore series, presenting purplish altered slate or quartzite, of considerable thickness, among greenish and grey and cream-coloured rusty-weathering quartzite. About forty yards below the lowest of a succession of fine falls are dark bluish-grey slaty layers which ought to yield fossil plants.

Contact with Carboniferous

Between the falls and the overlap of the Carboniferous at the pond at the rolling mills, are occasional outcrops of cream-coloured, greenish and red, mottled, micaceous, very fine rocks. The conglomerate is reddish, contains pebbles of all these rocks, and its contact is well seen in the brook which here enters the river from the eastward, nearly parallel with the Base-line road.

Above the tributary, the river shows only small detached outcrops of greenish, flinty, layered quartzite or gneiss and slate, which occur for only a short distance up, red syenite and epidotic chloritic dark diorite, often with thick and thin banding or jointing, and with masses of whitish nearly pure quartz, extending to the head of the river, sometimes one sometimes the other predominating, the diorite being blotched and veined with syenite in very many instances. In one of the branches is an interesting "pudding-stone" consisting of a paste of reddish and whitish syenite, in which are pebbles? three inches and downward, of dark greenish fine diorite; and in the immediate vicinity is a jointed diorite veined with syenite.

West Branch of Great Village River.

Up stream from the nearly vertical exposures of Carboniferous sandstone, shale and conglomerate of the neighbourhood of the Base-line road, the west branch of Great Village River* exposes grey slate and quartzite, bluish and grey fissile, ferruginous, unctuous slates, with small veins of quartz and ankerite. At the wooden bridge at the falls, the rocks are more or less massive, rubbly, full of ankerite in spots, blotches and minute veins. They dip up stream, are sometimes blue or lilac, but generally cream-coloured, grey or greenish. Where the gorge begins, there is a band of blackish, slaty, veined argillite. Opposite the old charcoal-furnace, excavations have been made and considerable quantity of white ore or carbonate extracted from the hill on the west. At the first dam above are greenish argillites, followed up stream by purple siliceous argillite and grey sandstone to the iron bridge on the Cumberland road, where diorites occur among the bedded rocks. Then for a considerable distance follow alternations of quartz-veined bedded quartzites, micaceous schist and hornblende-schist and diorite, followed by syenite with gneissic foliation and by mixtures of the two rocks which extend towards the head of this branch of the river.

Londonderry iron mines.

Cook's Brook.

In Cook's Brook, west of Great Village River† immediately above the Base-line road are dark graphitic slates, full of veins of ankerite, specular iron and limonite and too twisted to show fossils; succeeded up stream by grey and greenish and cream-coloured, rusty-weathering rocks, sometimes soft and argillaceous, sometimes flinty and quartzose. Among the grey rocks are blotches of plum-coloured sandstone and shale. About 300 yards above the Base-line road is a band of blackish, micaceous, sandy slate, marked with narrow impressions of stems of plants. Up stream, greenish and grey soft shales are succeeded by greenish-grey, massive, compact, flinty argillite and sandstone or quartzite, spotted and veined with specular iron, at one time largely mined by two long tunnels driven into the steep banks on opposite sides. In a pit sunk in 1890 in the bed of the brook by Ned Langille and others, specular iron and ankerite were found in a vein, said to be from two to five feet thick, running up stream between the tunnels and perhaps on the line of the old workings higher up, above which a grey and greenish-grey, massive, quartz-veined, flinty sandstone or quartzite occupies the brook, the pasture land at its head and the hillside as far as the river.

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* Acadian Geol., p. 582.

† Geol. Survey Rep. for 1872-73, p. 23.

Fossil plants.

Iron mines.

At the head of Martin's Brook, dark fine diorite is in contact with grey and light-coloured, altered, massive quartzite and purplish argillite. A short distance down stream, purple argillites are interstratified with greatly altered, cream-coloured, grey, purple and olive argillite and quartzite, resembling the rocks of Baxter Brook; and near the road is one of the deepest shafts on the iron ore veins of the West Mines.

Martin's Brook.

In Cumberland (or Spencer) Brook the iron ore rocks again succeed the Carboniferous above the Base-line road, the first seen being black graphitic slates or shales, succeeded at a fall fifteen feet high, by reddish porcellanous argillite in contact with dark bottle-green, flinty, massive, more or less porcellanous rock, in part resembling volcanic breccia, stained with hematite and chlorite, like a rock seen in Martin's Brook, and with compact flinty porphyritic quartz-felsite. Higher up stream are the light grey quartzites, associated with grey, greenish, yellow and purple quartzite, which have been largely mined; and, at a fork of three branches, with greenish-grey and dark shales and flags which show blackened markings almost certainly of fossil plants. In the east branch are light greenish and grey rusty-weathering shale and flinty sandstone, succeeded by dark greenish dioritic rocks, causing cascades, and by mixtures of altered flaggy sandstone and purplish porcellanous argillite, with dark hornblende-rock and schistose, chloritic diorite, blotched with red syenite, which continue to the head of the brook. Similar mixtures of sedimentary and igneous rocks are found in the middle branch, which follows the Cumberland road. In the west branch a level has been driven in fine, rusty-weathering quartzose rocks, veined with ankerite, from which a considerable quantity of ore seems to have been taken.

Cumberland Brook.

Igneous rocks.

The rocks of Matheson Brook require no special mention, they resemble those found in other streams of the neighbourhood.

Portapique River.

One of the finest exposures of Devonian rocks is found in the gorge of the Portapique River after passing, on the lower part of the river, red Triassic sandstone and conglomerate and nearly vertical outcrops of grey and red Carboniferous sandstone and shale. The dark shales, flinty sandstones and quartzites appear in cliffs, and among certain coarse grey sandstones, in black and grey, lenticular, mottled beds on the left bank, a large quantity of carbonized vegetable debris was found. These lenticular beds resemble underclays, but are greatly altered. The associated dark shales yielded only obscure fragments of plants, but closer examination might lead to other discoveries. The fossil-bearing beds have veins of ankerite and limonite, and are strikingly like the dark sandstone of the west branch of North River, above the Earltown road. At the mouth of Otter Lake Brook, diorite is in contact with gneiss or greatly altered micaceous sandstone, almost certainly that seen below, and similar alternations extend for a considerable distance up stream. Between Sutherland Lake and the river stratified rocks in abundance are met with.

Plant remains.

Big Bass river.

For some distance above the bridge over Big Bass River on the back road the intervale is low and no rocks are exposed. Then follows an outcrop of light grey, soft, Triassic trap, in part amygdaloidal, with black spots, weathering or separating into more or less globular masses. The next rocks up stream are grey and reddish broken sandstones and shales, in all probability Carboniferous, greatly tilted and broken, among which a bed of grey thick-bedded, unusually fine sandstone has been quarried for building; it shows numerous markings of plants, streaks of mineral charcoal and coal, contains patches of conglomerate and grit and bands of light grey concretionary limestone-conglomerate. These are succeeded in cliffs in a gorge by quartzites of the iron ore series, associated with syenite and diorite. At the junction is a loop of the river round a little island of Devonian rock. Higher up occur alternations which are shown on the map.

Devonian and Carboniferous

Birch Hill boss.

Near the shore east of this river, the prevailing Triassic of the neighbourhood is interrupted by a knob called Birch Hill, in which are good outcrops of the red quartzites of Union, containing quartz veins and traces of specular iron ore in small veins and blotches. These veins have been prospected in little pits, one of which is twenty or twenty-five feet deep, but no promising quantity of the ore seems to have been obtained.

Little Bass River.

Contact of Carboniferous

Carboniferous with coal.

Little Bass River at and below the run which goes to Bass River, shows outcrops of grey and reddish, coarse and fine, rubbly, probably Carboniferous sandstone, with bands of reddish and dark grey crumbly argillite, with very small veins of calcspar and limonite, interstratified with bands of limestone-conglomerate passing into a pure limestone, among the pebbles of which are many of red syenite. The dip is up stream nearly to the contact with the older rocks, the last beds consisting of coarse conglomerate, with layers of reddish and grey, fine, flaggy grit and sandstone, in falls; the pebbles being of syenite, diorite, quartzite, and other rocks of the mountain. There is a concealed gap of only seven yards between this and a dark argillite with lenticular masses of dirty limestone—the first of the Devonian—beyond which is a band of dark grey, coarse, Carboniferous conglomerate which occupies fifteen yards in the brook, above which, however, there is no break in the continuity of the iron ore series, as developed at the Londonderry mines, their identity with which is indisputable. Some of the grey and greenish olivaceous shales contain obscure impressions of plants, and certain grey sandstones look like underclay, while higher are the grey and rusty quartzites of Cook's and Martin's Brooks, full of grains of specular iron. Greenish and grey and purple sedimentary rocks extend thence to the great fall, at which flinty syenite, diorite and other igneous rocks show a sort of rough bedding, like that of Economy Falls and seem to have greatly altered the sedimentary rocks. West of the falls, on the hill in McLellan's clearing, are outcrops of dark diorite, in part gneissoid, followed nearer the house by a narrow belt of dark grey Devonian slate, and that by reddish coarse and fine Carboniferous rocks in which is the small coal seam worked at Robert Young's.

On the back road in the next brook, which crosses west of the school, Triassic conglomerate extends nearly up to the saw-mill, about 60 paces below which, however, in a run from the westward, and again about 200 paces below it, is a mass of light grey vesicular trap, mixed with the conglomerate which seems to contain pebbles or boulders of it. At the mill, grey and greenish rusty sandstone and shale, with red bands, dip nearly vertically down stream; while half way up the mill-pond the dip is very steepy up stream. These rocks resemble the coal-bearing strata at Young's, and are probably Carboniferous.

In the next brook to the westward, grey and reddish Carboniferous flags and sandstones show a nearly vertical dip up stream, are associated with coarse grit and conglomerate, containing pebbles of the iron ore series, and are succeeded, near the head of the brook, by grey Devonian quartzites. Below the road, Triassic conglomerate and sandstone are exposed to the fork of the brook from the school; but on the road, a short distance to the southward, these are succeeded by grey, flaggy sandstone and argillaceous shales, like those of Economy River, which extend nearly to the shore and are again succeeded by Triassic.

In the second brook to the eastward of this road, at a bend from the eastward, not far from the shore, Triassic sandstone grit and conglomerate, with impure argillaceous limestone, dip eastward 38°, in high sloping cliffs, immediately behind which lie unconformably blackish shales, holding *Naiadites*, *Cythere* and other fossils, strongly resembling the dark shales of Port Hastings, and other points on the Strait of Canso, interstratified with red shales and very coherent, micaceous sandstone or quartzite.

Fossil shells.

The outcrops of blackish shales, holding *Naiadites*, *Cythere* and other fossils, associated with red shales, which include bands of very coherent micaceous sandstone or quartzite, seen below the Triassic in the little brooks on the shore towards Economy River, are probably Devonian.

Fossil plants.

The rocks of the lower part of Economy River have been described by Dr. Ells*, and a careful survey of the relations of the fossiliferous, quartz-veined slates to the syenites and diorites of the gorge above the falls was made in 1877 by Mr. Scott Barlow, who discovered in the former indistinct vegetable fragments and obscure *Orthis*-like forms of the gold mine at the mouth of Peleg Brook. Immediately above Economy Falls are great cliffs of greenish argillite, passing into gneissic rock with coarse diorite, syenite and compact quartz-felsite, which prevail thence for two miles to the fork of the river, interrupted only by patches of greenish-grey slate. At the fork are cliffs of grey, massive, compact or obscurely granular quartz-felsite. Above it is the following succession measured along the windings of the west branch, which will give some idea of the mode of occurrence, the exposures being nearly continuous:—

Section of West Branch Economy River.

| Paces above the Fork. | |
|---|---|
| 200 | Dark dioritic rocks among the prevailing felsite and quartz-felsite. |
| 700 | Felsite and quartz-felsite, including a patch of bluish sedimentary rock or slate. |
| 1000 | Reddish, compact, flinty quartz-felsite, at a little brook from the west. |
| 1300 | Red, jointed, compact felsite and quartz-felsite, with grains of hornblende ; sometimes fine-grained. |
| 1387 | A large outcrop of slates begins. Greenish and bluish-grey, highly altered, jointed, broken slates. |

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* Geol. Surv. Rep. for 1885, p. 49 E.

| Paces above the Fork. | | |
|---|---|---|
| 1396 | The slates are associated with flinty, porcellanous sandstone or quartzite, containing grains of pyrite. | |
| 1482 | Slates with bands of quartzite ; small veins of quartz. Certain dark bluish-grey rusty beds, very like the darker portion of the Londonderry iron ore series ; rubbly, with the bedding obscured by cleavage. In the planes both of jointing and bedding are films of specular iron ore. Certain bands have a peculiar appearance, as of altered underclay, so often noticed in the iron ore series. One small patch of red syenite, like a vein in the slates. | Syenite dyke. |
| 1494 | Light grey, cream-coloured and rusty slates, containing veins of specular iron ¼ of an inch thick. | Specular iron ore. |
| 1620 | Rusty slates continuous to this point. Then an exposure of dark bluish-grey slate. | |
| 1700 | Greenish grey, schistose quartzo-felspathic rock which may be of igneous origin. | |
| 1790 | Reddish and grey, massive, compact, flinty felsite. | |
| 1797 | Greenish-grey, flinty, porcellanous, slaty argillite. | |
| 1865 | Chiefly slates, to a small logging-dam, 6-feet fall. | |
| 1921 | Greenish slates, to another dam and fall. | |
| 2080 | Reddish and grey, compact, flinty, porphyritic felsite, with blotches of quartz, exposed in a cliff. Then a rough stretch of the river, showing alternations of igneous rocks with slates and greenish quartzites. | |
| 2380 | Greenish slaty porcellanites, at a little brook from the eastward. | |
| 2457 | Greenish slates at a dam. | |
| 2620 | Greenish slates cut by a greenish-black fine hornblende-rock. | |
| 2650 | A cliff on the left bank shows a few obscure markings of plants in greenish-grey, evenly bedded, flinty shales and quartzites. | |
| 2745 to 2760 | Blackish, graphitic, slaty shales, in a cliff on the right bank, yield plants among which Dr. Ami has detected *Cyclopteris (Aneimites) obtusa** and obscure impressions of *Orthis ?* in abundance. | Fossil plants |
| 2855 & 2916 | Blackish quartz-veined slates, well exposed. | |
| 2970 | Greenish, flinty, greatly altered slate. | |
| 3026 | Light grey and rusty slate and quartzite with quartz veins. | |
| 3210 | Greenish coherent slate, dipping steeply down stream at a little brook from the eastward. | |
| 3220 | Darker, somewhat papery slates or shales. | |
| 3446 | Light and dark shaly and slaty argillites, with very few hard bands, at the mouth of Peleg Brook. | |
| 3490 | Very black shales. | |
| 3510 | Slates lighter in colour. | |
| 3533 & 3590 | Greenish, rusty slate, with bands of quartz, at two little dams. | |
| 3730 | Greenish, more flinty and quartzose rocks. Outcrops now become fewer. | |
| 3850 | Greenish, flinty quartzite in thick beds. A little brook from the eastward. | |

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* Dawson's Fossil Plants of the Devonian and Upper Silurian, p. 45.

| Paces above the Fork. | |
|---|---|
| 4360 | Greenish, flinty slate and sandstone at a little brook from the westward. |
| 4435 | Greenish, fine, epidotic trap or diorite begins. |
| 4483 | Greenish, reddish and purplish amygdaloid, then amygdaloid and diorite. |
| 4551 | A patch of reddish, greatly altered argillite and nut-and-egg conglomerate, containing pebbles of reddish quartzite, mixed with purplish amygdaloid. |
| 4555 | Dark green, fine, epidotic, flinty diorite. |
| 4570 & 4600 | Outcrops of grey amygdaloid and purple trap. |
| 4670 | Bridge on the road to River Philip, at a large driving-dam above the road. Outcrops of grey amygdaloid and diorite, with a small exposure of greenish, soft, slaty rock between the dam and the road. |

Similar alternations are found on the road from this dam to the settlement of Ebbtown, while to the north past Simpson Lake the blocks and cliffs seem to indicate principally red syenite.

Economy Falls.

At the foot of Economy Falls* the rock seems to be igneous, but has an appearance of being in steeply inclined thick beds. Down stream, however, reddish or indian-red Carboniferous conglomerate, with layers of grit and sandstone, occupies a considerable breadth in the river, dipping first southerly, then vertical and very highly inclined, below which is a great breadth of dark grey and rusty sandstone and argillaceous shale containing ironstone nodules, with bands of pebbly grit, resembling coal measures or the rocks of Debert, the high variable dip indicating faults. At the turn of the river to westward these rocks are succeeded by cliffs of brick-red, coarse, pebbly grit, probably Triassic, dipping down stream at a low angle, but afterwards steeper and variable, which occupies the river to the bridge on the road to Beaver Meadow, where the Triassic gives place to rubbly rocks, resembling those of Union, which contain a few greenish and bluish-grey bands, dipping at a high variable angle. Lower down the road follows the river which exposes dark and light grey rocks, which may represent the grey and black slates of Peleg Brook, and extend nearly to the iron bridge on the shore road, where Triassic rocks are again in place and the land is low and good.

Rocks probably equivalent to the Devonian of Union are also seen on the road from the post office to Ebbtown as far as the top of the hill, beyond which the debris indicates Carboniferous Triassic.

Slates similar to those just described in the west branch occur in the Chain Lakes Brook and other tributaries of the east branch

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* Acadian Geol., p. 557.

**Fossil plants.**

of Economy River. In Murphy Brook is a great breadth of dark slates, some beds of which are "full of leaf stalks of ferns, but only remnants of fronds. The stalks are like those of *Aneimites Acadica* of the Lower Carboniferous."*

**North River of Five Islands.**

Kerr Brook and all the rivers of Five Islands to the westward show fine alternations of Devonian sediments and igneous rocks. The altered shales and quartzites of the North River, containing traces of *Cordaites* and other plants, are described by Dr. Ells as Devonian, as including the Londonderry Mines series†, and as identical with the quartzite series south of Truro. No line of separation between them and the iron ore series seems here possible; on the contrary the greatly altered rocks of the latter are sometimes succeeded by less altered beds yielding fossils, and in most cases the greatly altered rocks are immediately in contact with diorite and syenite, which appear to have been the cause of their alteration.

**Harrington River.**

**Fossils.**

The various slates and quartzites of the west branch of Economy River are repeated in Harrington River,‡ and also on the road to the pretty little settlement of Lynn. Among the slates of the lower part of the river were found "fragments apparently of crustaceans—one may be an *Estheria*—and a small Cyclopterid leaf, resembling a *Cardiopteris* of the millstone grit, but very imperfect."§

**Coal.**

**Dykes.**

On Harrington River between the mouth of Boyd Brook and the shore road, light grey sandstone or quartzite is interstratified with blackish argillaceous shales, with greenish shales and underclays, the shales containing *Cordaites* and other fossil plants, layers and nodules of ironstone, and dipping steeply down stream. Above Boyd Brook for about 1,000 paces to an old dam, the black shales, besides the usual abundance of *Cordaites* and *Calamites*, show delicate branching ferns and the crustaceans mentioned above, and include a coaly layer. About 75 paces above this dam they are more altered and in contact with greenish granular, coarse and schistose, syenitic or dioritic rock, containing many grains of specular iron. For 250 paces higher the rocks are chiefly cream-coloured quartzites and slates, traversed by thin veins of claystone, with small porphyritic crystals, succeeded by a small dyke of massive crystalline diorite, on both sides of which are reddish compact quartz-felsite and syenite. Alternations of sedimentary and igneous rocks, found higher, contain veins or blotches of quartz and calcspar which have been prospected, some of the red and green slates resembling those at the base of the Union series. Near the fork are reddish flinty quartz-felsite and felsite with apparently a north-easterly dip.

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* Determined by Sir J. W. Dawson, from a few little pieces sent to him, but large slabs covered with these impressions are in the Museum.

† Geol. Surv., Ann. Rep., vol. I., 1885, pp. 50 and 53 E.

‡ Ibid., p. 50 E; Acadian Geology, p. 264.

§ Determined by Sir J. W. Dawson.

Shore of Minas Basin.

From the post office at Lower Five Islands, the road towards Parrsboro' runs across a plain and shows only debris of grey and bluish-grey flinty rocks as far as the bridge over Harrington River. Immediately below this bridge, on the right bank of the river, are outcrops of grey, flinty, jointed sandstone or quartzite, forming a prominent hill, interstratified with grey argillite with impressions of fossil plants. The dip seems to be 62° $<$ 17°, which is also the direction of certain striæ, which may be glacial, on a smooth face of the rock on the river bank. About 150 paces below an old dam, dark shales and grey, flinty flags dip 60° $<$ 67° and a few paces lower are more nearly vertical; they resemble the rocks of Riversdale and are well exposed to within 150 paces from the mouth of the river, where they are succeeded by indian-red, soft, marly, Triassic sandstone and conglomerate, with many concretionary, nodular patches, associated, a few feet further along the shore, with brick-red sandstone which occupies the shore for some distance; the Devonian rocks coming very nearly upon the shore in several of the small brooks. The dip of the Devonian a short distance from the contact is 27° $<$ 67°; that of the Trias is westerly at a low obscure angle. The contact of the Triassic sandstone and Devonian is also seen on the road from Harrington River to Blue Sack, which comes to the shore at the mouth of a little brook, a short distance west of which the high cliffs expose reddish and grey soft sandstone, somewhat altered, mixed with globular masses of trap. Immediately to the westward at the mouth of another little brook, a breccia of grey flinty rock with a paste of red gypsum perhaps indicates a Carboniferous outlier. Here the Devonian rocks also come to tide-water, although at ten paces further, Triassic sandstone is on the shore, mixed, at 125 paces, with trap-conglomerate overlaid by concretionary calcareous marl. The high cliffs of red Triassic rock with bands of greenish-grey coarse sandstone which then fringe the shore for a great distance, produce a fine scenic contrast with the thick layer of dark boulder-clay—composed of debris of the dark shales or slates of the Devonian—which in most places caps the cliffs or falls in great masses to the beach. Then come cliffs of the Riversdale rocks, cut by small veins of quartz and ankerite, contorted and jointed, full of fossil plants, black shales predominating as far as the mouth of Moose Creek, and beyond it interstratified with flinty flags. Past Moose River, which has a narrow rocky mouth, grey, rusty-weathering quartzites, in thick layers and wavy bands, with

Contact of Triassic.

Blue Sack.

Moose Creek and River.

a large quantity of comminuted carbonaceous matter, include only small beds of dark shale. Not only is iron ore present in the joints and in veins, but the dark shales have also many layers and nodules of clay ironstones. The bright green massive rocks immediately west of Moose River are like those of the shore west of Clarke Head, of Port Greville and also like those which overlie the dark strata of Riversdale; and above them seem to come the red rocks of Wasson Brook and Swan Creek, above which lie unconformably the gypsum and limestone series of Clarke Head. At 310 paces from the river, dark bottle-green and red trap—which has been seen below high water for some distance back—mixed with red Triassic sandstone, succeeds Devonian rocks, which are again, however, on the beach at 83 paces further; and similar alternations are found beyond as far as Wasson's Bluff. The traps are here in part blackish hornblende rocks, in part roughly columnar. In some places the Triassic sediments dip into the basin at a very low angle; but the number of points at which the ends of the beds strike against the black shales or appear to dip under them where they are all but in contact seems to indicate great faults which affect even the Triassic and are not apparently dependent on the intrusion of the trap.

Iron ore.

Carboniferous of Clarke Head.

Near Moose Creek the Devonian rocks come to the shore of Minas Basin and to the westward are exposed on the coast, as well as up the rivers and brooks, in contact with Triassic sandstones and traps and with Carboniferous limestone, so that several fine examples of the unconformable superposition of the limestone upon the Devonian can be distinctly seen.

From Moose River mouth westward along the shore-road are outcrops of light grey flinty sandstone or quartzite and dark shales also exposed in two small brooks nearly to the shore. Opposite the Two Islands (the Brothers) dark Triassic trap is in the road, while in a little brook north of it there are ledges of quartzite, and westward along the shore and in the brooks they alternate with red Triassic sandstone, as shown on the map. Up the brooks east of Wasson's, the red rock of Union are exposed. On the post-road, from the bridge on Parrsboro' River for some distance towards Five Islands only drift is seen; then, near the top of the hill, dark and light grey flinty rocks, like those of Moose River, and probably Devonian.

Two Islands.

At the mouth of Phinney's Brook are outcrops of slate like that of the East River of Pictou at Sunnybrae, netted with small veins of quartz, calcspar, ankerite, &c., with beds of compact quartzite. Immediately above these lies a great mass of limestone, rusty, bluish-grey and whitish, the upper part white, brecciated, apparently

Phinney's Brook.

Crystalline limestone.

intimately associated with the slates, which at one point it seems to vein; it is crystalline and full of spots of pyrite, shows a little arch and cave, and is interstratified with greenish brecciated sandstone containing specular iron. In contact with these rocks to the eastward are dark, pearly slates with bands of quartzite; then an interval of drift, succeeded by greenish and cream-coloured rocks, like those of the pinnacle west of Clarke's Head—the olivaceous rocks of Londonderry—soft and hard, rubbly, with brecciated, rusty-weathering veins. At a little brook are black twisted slates; then another mass of brecciated limestone, often crystalline, possibly a vein, but more like a mass irregularly bedded among the black slates. Pearly, soft, graphitic slates then stretch along the shore, weathering so as to look like the outcrop of a great seam of coal, crumpled, wrinkled, polished, cleaved and full of veins; they do not seem to promise fossils.

Natural arches and dykes.

About 300 paces before reaching a little island of rock and natural arch is a small outcrop of greenish, fine diorite, succeeded, 80 paces nearer the arch, by dark, flinty, altered slate or porcellanite. The arch itself is of similar porcellanite with an immense number of quartz veins. Past it is a little brook and beyond this—all the shore being of black slate—another, called Henning's Brook, on the left bank of which the black slate contains lenticular masses of breccia, also a mixed rock containing black slate, quartzite, limestone and lenticular masses of schistose rock. Then follow greenish rocks, slaty but otherwise like the foregoing, in a great thickness of dark slate. Dark diorite and fragmental rock, on the beach below high water, stretch past the first of the Brookville brooks to rise into a cliff at the Big Rock; but in the bank the dark slates, with light grey and greenish-grey layers of soapy rock, extend to the next natural arch. Immediately past De Wolf Brook are fine cliffs of greenish, brecciated, rather massive rocks, apparently largely dioritic, behind a mass of which, in a small cove, are reddish and greenish, mottled, rubbly slates; succeeded by reddish, greenish, cream-coloured and black slates, greatly mixed and like rocks near the pinnacle. The Big Rock projects nearly to low-water mark and consists of red, compact felsite and quartz-felsite, in contact with which are the black slates which stretch along the shore past four little brooks, and contain crystals and aggregations of pyrite. Soft, soapy, graphitic matter is found in a hole at the Big Rock.

Henning's Brook.

Brookville.

Port Greville.

The rocks of De Wolf Brook, below the coal, are described elsewhere. Along the shore from Ward Brook to the mouth of Greville River and up the left bank to the road black slates prevail; but from this point to the mouth of Fox River only banks of gravel are found; at the mouth of Fox River is a deposit of fine sandstone, whereas, immediately beyond, the Carboniferous rocks are exposed. Carboniferous

Swan Brook. In Swan Brook, above the road, are light grey and whitish Devonian sandstone or quartzite and argillite, succeeded up stream by light grey, somewhat soft, flaggy sandstone, forming a rocky country, nearly barren; and by dark and light grey, sandy and argillaceous shales and flinty sandstone, with small veins of quartz, dipping 207° < 70°, and resembling the rocks of the North and Harrington Rivers. Below the road the brook comes to tide-water over a cliff of dark Triassic trap, in part crumbly.

Parrsboro River. The Devonian rocks of the Parrsboro' River are described with the Carboniferous. Those near the pier are red and green and grey, rippled, crumpled flags, with a large proportion of argillite, underlaid by dark shales and flags, like those of Horton Bluff, containing layers of limestone and of fine calcareous grit, as well as blackish bands full of broken plants.

## G.—CARBONIFEROUS.

Unlike the Devonian, the continuity of which is scarcely broken, the Carboniferous rocks occur in detached areas, as sketched on page 4. These will be described under the following groups, the general characters of which have been given fully in previous reports:

G. 1m.—Carboniferous conglomerate.
G. 1.—Carboniferous limestone.
G. 2.—Millstone grit.
G. 3.—Coal measures.
G. 1.—Carboniforous conglomerate.

### G. 1m.—Carboniferous conglomerate.

Following Dr. Ells and including in this formation the coarse sandstones and shales, with small seams of coal, which lie immediately south of the Cobequid Hills, (from which, however, he seems disposed to exclude certain grey rocks of Folly River)* the principal areas may be enumerated as follows:—1. Small doubtful patches on the east side of the East River of Pictou. 2. The detached areas north of the railway west of West River station. 3. A small narrow belt along the Truro road west of Saltsprings. 4. The patches of the Stewiacke Valley, including the conglomerate in which search has been made for gold Areas.

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* Geol. Surv., Ann. Rep. for 1885, vol. I., p. 47 E.

at Brookfield. 5. The long strip of irregular width on the south side of the Cobequid Hills, which occupies the railway between the Triassic of Folly River bridge and the Devonian of the foot of Folly Lake.

Pictou coal-field.

1. *Basal Carboniferous rocks east of the East River of Pictou.*—Among the greatly faulted rocks which surround the Pictou coal-field the conglomerate east of Sutherland's River, in McLaurin's Brook, down stream from the iron mines, is perhaps of this age The pebbles are principally of Devonian quartzite, sometimes three inches in diameter; and among it are a few grey beds. It is seen on a line of fault near the contact with the Silurian. In the vicinity is a greenish and reddish, impure, concretionary limestone, like that found at Park's Mills. Similar conglomerate occupies a considerable breadth in Sutherland's River between the north fault and Park's Mills, and extends up along McLean's Brook, where it is associated with or overlaid by gypsum and by the limestone of McDonald's.* This conglomerate is seen in the cuttings on the new road between the Vale colliery and McPherson's Mills. It is reddish, greenish and grey, and contains beds of red and grey sandstone, as that of Sutherland's River, marked with plants. The reddish, flinty, micaceous sandstone of the mill-dam may possibly be lower. The limestone has been somewhat largely quarried.

McGregor's Mountain.

On McGregor's Mountain a conglomerate, seen in contact with trap and Devonian sedimentary rock south of the south fault, is perhaps also of this age; and large outcrops of conglomerate are also found near Churchville.

2. and 3. *Basal Carboniferous Rocks of West River of Pictou and of the Truro Road.*—Above the railway near the 30th mile-post and on it east of West River station are large blocks of conglomerate, perhaps indicating a patch among the Devonian of the neighbourhood. Possibly a basin of Carboniferous may at one time have extended up the river to this point.

Watervale.

The reddish, grey and whitish soft sandstone, grit and conglomerate, west of Watervale, are well seen on the road up the large brook, as far as the crossing of this brook, and on those about Botany Bay Brook. They are like the rocks of Londonderry station, and like those of the Telegraph road between Mount Thom and Salt springs, from which they are separated by a ridge of Devonian which extends nearly to the valley of the Telegraph road at Reid's On this road to the westward is a cliff of grey conglomerate, loose in texture, which seems to lie in patches in the valley, and to be composed of fragments of the greenish Devonian slates of the vicinity, and of reddish-grey coarse syenite. From the second house west of Reid's, and immediately past the road to Bezanson's, a wood-road running north shows blocks of reddish conglomerate and grit, as far as the crossing of the first branch of the Juniper Meadow Brook; and the outcrops here are no doubt continuous with those of the road south of Bezanson's. North from Pat McAulay's, on the track to Lippincott's old clearing, and also at other points in the vicinity, conglomerate seems to be in place beyond the red syenite.

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* Geol. Surv., Rep. of Progress, 1866-69, p. 39.

On John McKay's track, as already stated, the barren shows blocks of reddish-grey grit and conglomerate, with pebbles as large as a hen's egg. Light grey, fine, flaggy sandstone is associated with the coarse rocks as far as the Watervale road; while on the west branch of the track the coarse rocks extend to within a quarter of a mile of McKay's, where they are succeeded by Devonian slates. In the large brook which crosses this track a few outcrops seen below the track seem to be of this age, comprising reddish-grey, fine and coarse, flaggy sandstone, indian-red soft sandstone and marl, lying at a low angle; reddish conglomerate and grit, and near the Black River, indistinct outcrops of reddish and grey fine sandstone and coarse grit. On the barrens are blocks of grey and reddish-grey, fine, flaggy, somewhat soft sandstone. But on the railway are cuttings of the flinty rocks, perhaps along one of the many faults of the district or unconformably beneath the conglomerate.

**Fault or unconformity.**

**Steele's River.**

Possibly some of the outcrops along the Truro road are continuous with those of Steele's (Irving's) Run, but the latter seem rather to be detached. About half a mile above Salmon River, a bank of reddish conglomerate and sandstone seems to follow the brook. The conglomerate contains pebbles of whitish quartzite and of red sandstone; it is overlaid by layers of indian-red, soft, crumbly, fine sandstone and marl. Grey, greenish and drab, fine sandstone, glistening with quartz and covered with impressions of fossil plants, occurs higher up the brook, and about one mile and a half from the river these give place to the iron ore rocks, beyond which, in a little brook from the north above the marshes, Carboniferous rocks again appear with a vertical or very steep dip, being here dirty greenish-grey, soft, rusty-weathering shales, with reddish-grey, flaggy, fine and coarse grit.

On the road along Salmon River, below Jacob Fenton's, are blocks of reddish and grey, flaggy, fine and coarse sandstone.

Unless these are drift, like the numerous blocks of grey sye and granite, they may indicate a Carboniferous outlier. Red, sandstones appear near the Telegraph road. On the road to I town, reddish flags prevail, which may belong, however, to the rocks of Union, as do most of the rocks of the vicinity.

Brookfield.

4. *Basal Carboniferous Rocks of the Stewiacke Valley.*—Associ with the limestone and plaster, which so largely prevail in the va of Stewiacke River, are small areas on both sides of the bi generally of little extent or importance, which will be descr with the associated rocks. The road from Brookfield to the mine passes over coarse grit and grey flags. Up to the first broo the north side of the river, above the road across the river to J ston's, the rocks first seen are brownish or reddish, flaggy thick-bedded sandstone and shale, interstratified with grey beds and with grey coarse conglomerate, made up chiefly of qu but having also pebbles of grey quartzite and fragments of d slate, perhaps derived from the Riversdale rocks, and of red s stone or quartzite, perhaps from the rocks of Union. To the I of this brook are many outcrops of grey grit and conglome probably Carboniferous and not unlike rocks seen north of the G

To the eastward above the mill in Bill Putnam's Brook are c grey shales which perhaps underlie the Carboniferous limest At and below the dam are alternations of very flinty, co quartzose grits, sandstones and shales. Down stream is a patc coarse conglomerate which seems to contain pebbles of these fl rocks and is perhaps Carboniferous; it extends to the boundar the limestone and gypsum.

Goldmine Brook.

About 170 paces above the road in the Goldmine Brook, g outcrops dip 217° < 35°; they show reddish conglomerate pebbles, larger than a hen's egg, of red and white quar and soft argillite; sandy and argillaceous flags, appare like the rocks described above. About 50 paces above an old dam, are other outcrops of reddish flags underlaid by grey, ru weathering, plant-marked sandstone and grit, very micaceous usually somewhat flaggy; associated with reddish flags. Al 180 paces higher, grey, coarse quartzose grit of similar tex appears to show a south-easterly dip; and 120 higher, indian- micaceous, soft, argillaceous rocks dip 228° < 65°. Then com long intervale or marsh, at the end of which, about 450 above last outcrops, the barren on the left shows blocks of grey, ru weathering, friable, quartzose sandstone. Then at a brook from left near the gold mine, the dip is 227° < 36°, as shown in the of light and dark grey, rusty-weathering, micaceous, sandy fl including bands of coarse grit and conglomerate full of pebbles of white quartz as large as a hen's egg, upon which the so-called gold mine is situated*. The pebbles of the conglomerate when not of quartz are with difficulty determinable; they may be of the whin and slate of the gold-bearing series or of the Devonian. The flags are of loose texture and do not resemble rocks older than the Carboniferous; although they may underlie the limestone and gypsum, which may be also the position of the grits and sandstones south of the Stewiacke River. Some distance above the mine, grey flags, a quarter of an inch thick and over, dip 219° < 49°, well exposed in cliffs and underlaid as before by grey, pebbly, quartzose grit and conglomerate. At a little brook from the left, a band of bluish-grey argillaceous shale or flag is included among the coarse grits, and at the next cliff on the right, dark micaceous sandy flags again show layers of dark argillaceous shale, though the coarse grits greatly predominate. Cliffs of grey flags and grits alternate to the uppermost of two dams across the brook, representing a great thickness of rocks of only these two varieties. Above the dams, a long boggy meadow obscures the rock for some distance, above which are outcrops of bluish-grey, fine, jointed, striped, argillaceous sandstone, interstratified with a considerable thickness of bluish-grey argillaceous shale. Only a small exposure is seen here; but higher up stream are grey and blackish flags and grits, precisely like those of the gold mine dipping 224° < 43°, extending as far as the brook shows exposures and northward to the red Devonian rocks of Little River.

Supposed gold mine.

5. *Basal Carboniferous Rocks of the Southern Slope of the Cobequid Hills.*—As already stated, there is nothing to fix the precise age of these rocks except their strong resemblance to the Lower Carboniferous of other localities, and as an immense thickness of them is sometimes exposed among the faults of the mountains it is not improbable, that assuming most of them to lie beneath the Carboniferous limestone and gypsum, higher beds may be brought in. And as at Parrsboro' but a small belt of conglomerate intervenes between limestone holding typical shells of the G.1. formation, it is not improbable that the latter as well as Millstone grit may be included. But the limestone is distinct at Valley, on Minas Basin, in the basins of the Stewiacke and Shubenacadie Rivers and also throughout a large portion of Hants county, so that in the absence of other evidence that of lithology will be followed. Fossil plants abound, but such evidence seems too vague and uncertain to settle the question.

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* Summary Geol. Surv. Rep., 1890, p. 41.

Upper North River.

These rocks are seen furthest east, in the various branches of Cranberry Brook, in contact with Devonian ferriferous slates. For a short distance above the bridge at Upper North River, and for more than half a mile below it, they are again in contact with the flinty rocks, from which they are separated on the north side by a fault, the course of which seems to be about east and west magnetic. They consist of reddish, somewhat crumbly egg-and-nut conglomerate, containing fragments of the rocks cut by the syenites and diorites, of reddish-grey coarse grit, and reddish, soft, crumbly argillaceous shale, not unlike the Permian rocks of the west branch of River John. They are also met with in all the little brooks of the immediate neighbourhood. In the middle branch, conglomerate is present, as already stated, for a short distance above the road, but on the hill between this settlement and McCallum's, there is apparently evidence of the want of conformity of this with the slate series, the latter appearing generally on the hill, while the conglomerate is present in both valleys. The conglomerate of the west branch of North River, near McCallum's mill, includes pebbles six inches in diameter, and is interstratified with patches of light greenish-grey, soft, coarse and fine sandstone. The cliffs above the mill-pond, however, show grey and reddish massive sandstone or quartzite, as hard and brecciated as those of Guysboro' and St. Mary's, belonging to the Devonian. The conglomerate first seen here lies at a low angle; and on the road it is exposed for at least 150 yards north of the mill.

Coalmine Brook.

Coal.

Coal mine.

Coalmine Brook, a tributary of this west branch, shows near its mouth, grey, greenish, rusty and reddish contorted shales and flags, the shales containing *Stigmaria* and nodules of ironstone. Up stream, a grey, coarse grit contains fragments of blackish, shiny, argillaceous shale, and masses of coaly rock, lenticular, and sometimes nine inches thick, from which layers of good bituminous coal, one inch thick, may be broken; coaly matter is again found in a flinty, grey grit and pea-conglomerate, in which *Stigmaria* is very abundant; and a lenticular layer of an inch and a half of bright clean coal, in grey shales full of large nodules of ironstone and interstratified with greenish and reddish, mottled, crumbly shales. The dip is variable, generally very steep. Greenish shales are found at the road to Delaney settlement. Above it, these rocks occupy a breadth of more than half a mile, with a dip increasing from an angle of 30° at the road to vertical where they come against the Devonian slates, the direction being southerly—they are grey sandstone, greenish shale and pea-and-nut conglomerate. About ten chains from the road are openings made on eighteen inches of stony coal; and about a quarter of a mile higher, flaggy, argillaceous shales include three feet at least of carbonaceous shale, from which in places a foot of shaly coal may be obtained. Small bands of coal occur higher up in lenticular layers in the shales and in streaks in the bedding of the grey and greenish conglomerates and grits which come against the Devonian rocks 140 yards above the fork of a little branch from a lake, the two formations for a short distance keeping on opposite sides of the brook.

Carboniferous and Devonian conglomerates

Some of the bands of nut-and-egg conglomerate interstratified with the grit and finer rocks of this Coalmine Brook not far above its confluence with the North River, give the key to the difficulty connected with the conglomerate and dark sandstones above Upper North River bridge in the middle branch, showing clearly that these latter belong to an older series, although at first sight it would be hard to distinguish them, the pebbles not being always distinctly identifiable, and those of the dark grey sandstone being readily confounded with those of a bottle-green, chloritic, weathered diorite so largely found everywhere with the syenite. The conglomerate of Coalmine Brook is largely made up of pebbles of dark grit and blackish coarse sandstone. If we assume therefore, that the shales and flags of this brook are G. 1m, as supposed by Dr. Ells, no further proof of the Pre-Carboniferous age of the pebbles would be necessary, and the underlying series must be Devonian. If however, the upper series be millstone grit, as supposed by Mr. Barlow, the rubbly rocks might be G. 1m, for they are equally unconformable to the Carboniferous limestone. Between the Devonian and G. 1m, there are still perhaps doubtful areas.

North River.

The outcrop in North River below the Coalmine Brook yields large pebbles of greenish sandstone and conglomerate, with others of red sandstone; it weathers red and has indian-red streaks and patches. Perhaps all the grey and greenish flags and shales in the river below, as far as the next conglomerate, which contain a three feet layer of dark carbonaceous shale with a quarter of an inch of good coal at top, may belong to this group. The conglomerate extends thence for fifty yards below a little brook from a lake on the west side of the river; and the rocks immediately down stream are more like those of Union.

Coal.

Chiganois River.

The conglomerate of Chiganois River, in the cliffs above Higgins' mill, contains pebbles of red, flinty sandstone and of the rusty rocks of the iron ore series, as well as of the syenite, diorite and felsite of the falls. It appears to be more altered than that lower down the river; but this appearance may be due to the smooth wearing by the river or to faulting; for a few paces higher are the rocks of which it seems to be composed and the boundary in this river and in the three brooks to the westward seems to be a straight fault.

Fault.

Coal.

In Higgins' Brook immediately to the eastward, the conglomerate is well exposed and holds traces of coal; and on the old Tatamagouche road it is seen nearly to the fork of the Coalmine Brook, On the Higgins' road west of the mill, grey, rusty-weathering sandstones are seen, and also in the brooks to the boundary of the Devonian a short distance above the road. In the first of these, a branch of Old Sam's Brook, the first rocks seen are igneous and altered; but in that which crosses the road a mile to the westward are grey and greenish-grey, fine and coarse sandstone, grit and nut-and-egg conglomerate, with pebbles of the iron ore series, the rocks resembling those west of Debert River and at Londonderry. Down stream in Old Sam's Brook, are outcrops of reddish-grey, broken, flaggy, somewhat coherent sandstone, in part calcareous, with rusty, grey, fine sandstone, often flaggy, but with few argillaceous beds; some of the flags are covered with impressions of fucoids and rain-marks. Grey, brown and reddish-grey, earthy, flaggy sandstone with carbonized plants, extends to a little stream from the left near Chiganois River, where conglomerate and more argillaceous rocks succeed. At the river here, coarse grit and conglomerate are found whereas lower down are red argillaceous shale and sandstone, spotted with green; and similar rocks extend up the river to Higgins' mill.

Succeeding the Triassic in Staples Brook, are dark grey sandstones, with reddish-grey belts, which extend to Higgins' road, but are not well exposed and may be in part Devonian.

Debert River

Coal.

The rocks of Debert River, at the mouth of Totten's Brook, have been already described. Higher up are bluish-grey and greenish shales containing a layer of clean coal of indefinite thickness and crowded with nodules of ironstone; they are associated with coarse, grey sandstone. Above the bridge at Cottam settlement is a repetition of the seam probably, which is eighteen inches thick. Immediately above this coal are outcrops of red conglomerate and coarse grit, as in North River (containing pebbles, sometimes one foot in length, of red syenite, green diorite, reddish and greenish, soft, slaty argillite, compact quartzite and quartzose grit), which seem to come against the graphitic slates above by a fault.

Fault.

Totten's Brook.

Coal.

The red sandstone and conglomerate seen near the river in Totten's Brook, are associated up stream with reddish and grey and rusty flags and shales, marked with *Cordaites*, *Calamites* and other plants, ripple-marks and rain drops; among them are layers of matted carbonized plants, passing into seams of coal sometimes an inch thick. Above the road to East Mines are frequent outcrops of grey, rusty-weathering, fine and coarse sandstone, with layers of whitish pea-and-nut conglomerate, and a patch of reddish coarse conglomerate, containing pebbles of syenite and of Devonian rocks, associated with dark grey, soft shales and flags, covered with impressions of ferns, *Calamites* and other plants, including a seam of coal more than two inches in thickness, and succeeded at a fall by the Devonian.

Coalmine Brook.

In the Coalmine Brook, another tributary of Debert River, the red rocks nearest the river are succeeded up stream by dark grey or bottle-green, somewhat massive, coherent, pebbly grit, overlaid by reddish-grey fine grit and conglomerate. Small seams of coal have been mined on this brook in several pits, but their dimensions could not be ascertained. The associated greenish, rusty-weathering, soft shales are crowded with ironstone nodules, precisely like those of the Coalmine Brook of North River. Above the road are outcrops of light grey or whitish, fine, soft sandstone, and of greenish-grey, rusty-weathering conglomerate, which extend to a house on a hill at the head of the brook, beyond which dark Devonian slates appear.

Pine Brook.

Pine Brook flows in a marsh or intervale from the Base-line road to a little brook from the west, at which reddish-grey Carboniferous sandstone and shale dip about 133° < 50° and are thence well exposed without great variety, forming an ascending section to a brook from the left, immediately below which red sandstone and marl lie at a much lower angle; again become higher and undulating, and at a fall dip 351° < 45°. Immediately down stream the angle is lower, then nearly vertical for a great breadth to a high cliff at a turn, where a greenish concretionary layer, embedded in the red sandstone and shale, shows a large quantity of broken carbonized plants. The dip is up stream, and one of the last rocks of the series is a grey and reddish pebbly sandstone. Not far down stream is a cliff of more altered, rubbly rock, fine, micaceous, generally red, but with siliceous flinty layers full of broken plants; it might easily be mistaken for a rock of the Union series, but is perhaps Carboniferous, its rubbly condition, the presence of limonite in the joints, and other appearances of alteration being probably due to faulting or to the proximity of the Triassic sandstone, which, 200 yards down stream, lies apparently horizontal. A similar appearance of alteration near a contact was seen in Salt-spring Brook, near its confluence with Great Village River, and another where the north fault of the Pictou coalfield crosses McCulloch's Brook. In a small branch of Pine Brook from the eastward, more than half a mile above the road in the Totten settle-

Altered rocks.

ment, is a small outcrop of conglomerate among and apparently unconformably upon the altered rocks of this brook.

At the East Mines conglomerate is nearly everywhere seen south of the openings on the iron ore.

Folly River

Where the Carboniferous conglomerate comes in contact with the Devonian rocks at a fall in Folly River, it holds pebbles of all the latter, those of dark diorite and syenite being very numerous and up to one foot in diameter. Below this point outcrops are continuous for a great distance, and the conglomerate is seen first to inclose bands and patches of reddish and grey and greenish-grey soft sandstone and grit, with large carbonized markings of plants, and afterwards to be succeeded by these rocks, which show prostrate trunks of trees and minute veins of coaly matter, overlaid by greenish and dark grey argillaceous shales, which contain *Stigmaria* and streaks of coal, one of which is an inch thick, in the bedding. Grey and brownish sandstones then extend to the bridge on the Base-line road, at which outcrops of conglomerate are again found, interstratified down stream with reddish sandstone and shale. A large proportion of the rock, for some distance below the bridge, is of conglomerate; but in one place a quarry of red sandstone shows included layers of concretionary limestone-conglomerate, grey, greenish or rusty in colour, with carbonized plants. Below the quarry are cliffs and ledges of indian-red and grey sandstone and shale, with strong, calcareous, concretionary bands. At their contact with the Triassic these rocks strike 243°, with a dip both ways at angles varying from 73° to 87°; and the Triassic rocks also, although not seen on the river section, seem to be faulted; but at the railway bridge they dip at a low angle.

Coal.

McElman Brook.

In McElman Brook, about half a mile above the fork, the doubtful flinty rocks are succeeded by grey and bottle-green sandstone and shale containing rootlets, *Calamites* and broken plants, interstratified with grey, coarse, pebbly grit, red soft marl and reddish and greenish sandstone, often calcareous and including a band of one foot of pure concretionary limestone-conglomerate, precisely like some of the Permian strata of Pictou and Tatamagouche. The sandstones are crowded with plants, one trunk, three inches in diameter, being converted into black spathic iron ore. The coarse rocks contain pebbles of black argillite. At and near the railway, the brook exposes cliffs of grey and greenish sandstone and conglomerate, darker beds, crowded with plants, and reddish shale, succeeded above by greenish egg and coarser conglomerate, with a low dip down stream, seen only a few yards above the railway, and followed by the iron ore rocks.

In the west branch of McElman Brook, the rocks which succeed the Triassic resemble those just described, and above the railway, outcrops of conglomerate are succeeded by flinty Devonian slates. On the railway, at the entrance of the snowshed near the 82nd mile-post, Devonian rocks are succeeded by nut-and-egg conglomerate holding large boulders of the former, interstratified with finer beds which, nearer Londonderry station, predominate to the junction with the Triassic conglomerate, the grey and greenish layers inclosing stumps, prostrate trees and *Cordaites*.

Saltspring Brook.

Below the mines-railway at Londonderry, Saltspring Brook cuts reddish, soft, flaggy sandstone and shale, dipping about 42° < 41° and containing grey beds fit for quarrying, small patches of conglomerate and greenish concretionary sandstone, as far as the Telephone line road. Below the road, similar rocks, jointed or rubbly, somewhat coherent, dip first 34° < 18°, and 120 yards below an old dam, 36° < 51°. Still lower, rocks precisely like those of the railway bridge dip about 16° < 72° and continue to Great Village River, about 150 yards above which is a light grey, greenish and rusty sandstone, in places a compact ganister, with *Stigmaria*, and three bands of blackish shale, one of which is coaly, interstratified with red rocks and nearly vertical. The hard bands are very flinty and rubbly.

Coal.

Above the mines-railway on Saltspring Brook similar beds dip about 52° < 33°, and a grey, flaggy layer has been quarried for rough building stone. About a quarter of a mile up stream, a black, coaly shale, overlying grey sandstone, has been worked in a shaft and several pits, and a quantity of coal from a layer at least one inch thick, and perhaps much thicker, lies on the bank. Grey sandstone has been quarried near the shaft and prevails for some distance up stream, becoming mixed with greenish coarse conglomerate and grit; and at the bridge on the Base-line road the coarse rocks predominate, striking about east and west with a vertical dip. From Great Village River to this point the section is, according to the dip, continually ascending, and many of the upper flags resemble Millstone grit and Coal measures in texture.

Great Village River.

A similar sequence is well exposed in Great Village River. At the dam, about 267 yards above the Base-line road on the east branch, is a coarse, Carboniferous conglomerate, which contains patches of grit and fine sandstone, and is succeeded down stream by light green, pebbly sandstone, with patches of conglomerate, and by grey sandstone, with layers of greenish shale and streaks of coal an eighth of an inch in thickness. At the dam the dip is doubtfully horizontal, while seventy yards below it red shales dip confusedly

Coal.

Fault.

Quarry.

Triassic.

147° < 80° and are succeeded by blackish shales, including layers of whitish flinty sandstone. In the black shales are siliceous concretions and concretionary, rusty-weathering layers. They are again followed by red sandstone and shale, with one carbonaceous layer. At 325 yards below the bridge red shales and sandstone dip 12° < 15°, while at the bridge close by, on the road down the river, near the fork of the rivers, grey and greenish, rusty-weathering, coarse and fine sandstones dip 157° < 47°. At forty-five yards below the fork, red, soft rocks are nearly horizontal, showing a dislocation between them and the sandstone of the fork. But immediately below is a pebbly band which may be the conglomerate of the fork, dipping 17° < 18°, while a few yards down stream are dips of 87° < 25° and 57° < 27°. Thence to the fork of Cumberland Brook the dip is about 43° < 37°, on red rocks, including ledges of grey sandstone and coarse grit. Immediately below this brook is a quarry of rough, grey sandstone. Down stream are reddish sandstone and shale; grey sandstone, fine and coarse, some beds rippled, rusty-weathering, holding carbonized plants, with bark converted into coal, dipping 5° < 42° to a point nearly a mile below Cumberland Brook, where the dip is 12° < 80° and the rocks differ from those seen above in being finer in texture, flaggy or evenly-bedded, rubbly and perhaps more coherent. They are all reddish, rusty and greenish in colour, full of broken, carbonized plants, and include a layer of blackish, papery shale, with lenticular bands of ironstone, precisely like the adjoining rocks of Saltspring Brook, about 250 yards below which they are overlaid by coarse conglomerate, with patches of nearly horizontal Triassic sandstone.

Cumberland Brook.

Up Cumberland Brook to the mouth of Cook's Brook, reddish sandstone and shale, with patches of grey and red conglomerate, full of broken, carbonized plants, dip about 12° < 41°. They are exposed up the latter with a somewhat lower dip for some distance, after which they dip 55° < 21° to the Base-line road, above which the dip is 172° < 67° and higher, to the contact of the slates. Between Cook's and Martin's Brooks, reddish, brownish and grey sandstones and shales are exposed in cliffs, dipping about 345° < 31°, but disturbed near the mouth of a little brook from the south, as shown by two dips of 355° < 80° and 247° < 19°. Not far below the Base-line road the dip is 352° < 27°, above which no rocks are seen to the Devonian slates.

Black shales.

Immediately below the main road in Cook's Brook, the reddish conglomerate and grit contain bands of black graphitic shale with hard nodules. Good outcrops are seen everywhere in the neighbourhood of the iron mines.

These rocks as they occur in Portapique River and other streams to the westward have been described with the Devonian.

In Crowe Brook, above the Base-line road, greenish-grey breccia and olivaceous shale of the iron ore series are in contact with coarse, flaggy, Carboniferous sandstone and conglomerate, dipping about 157° < 80°. Below the road and near a mill-pond, reddish-grey sandstone and marl and greenish and grey flags and sandstone dip about 6° < 43°-90°, and are succeeded above the settlement of Montrose by Triassic conglomerate and sandstone. **Triassic.**

### G. 1.—Carboniferous Limestone.

This formation is characterized by the occurrence of gypsum, limestone, sandstones, marls and other soft and friable rocks, apparently everywhere unconformable upon all the underlying formations.* It appears at the following localities, from most of which fossils have been described by Sir J. W. Dawson†, Sir Chas. Lyell‡, and others: 1. In a basin along the East River of Pictou, and in isolated areas at the south-eastern corner of the Pictou coal field. 2. In small areas on the Middle and West Rivers of Pictou. 3. In broken areas of small extent north-east of Valley and Truro stations, in Farnham's Millbrook and on Penny's Mountain. 4. A large and important basin along the Stewiacke and Shubenacadie Rivers. 5. In outliers on the north side of Minas Basin.

1. *Basin of the East River of Pictou.*—Reference has been made already to the narrow basin of these rocks which the East River follows from above Sunnybrae to Bridgeville, and which then expands between the Pre-Carboniferous rocks of McLellan's Mountain and those of Middle River.§ The small patch shown on the map as of this formation at Fall Brook displays limestone blocks only, and the valley, although very like a Carboniferous glen, may, perhaps, indicate only the contact of the Silurian and Cambro-Silurian.

**Fall Brook.**

**McLellan's Brook.**

In McLellan's Brook, where the limestone overlies the Cambro-Silurian, it strikes vertically 20°, and is streaked with marl and patches of grey conglomerate; it has been quarried and is overlaid by reddish shales with green blotches. Where quarried, near the Mountain road, it is coherent, veined with calcspar and associated with grey and reddish sandstone.

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* Geol. Surv. An. Rep., Vol. II., 1886, Part P, p. 69; Proceedings of the Geol. Soc. of London, vol. III., p. 712; Lyell's Travels in North America, vol. II., pp. 148, 177-183; Summary Report of Geol. Survey for 1891, p. 35.

† Acadian Geol., pp. 285-316.

‡ Geol. Soc. of London, vol. IV., p. 185.

§ Geol. Surv. An. Rep., Vol. II., 1886, Part P, pp. 86 and 109; Trans. Roy. Soc. Can., vol. IV., pp. 159-163; Acadian Geology, Supplement, 1878, p. 76; Trans. N.S. Inst. Sc., vol. III., p. 63; vol. IV., pp. 143, 144, 161, 163, 465; vol. V., pp. 31, 65, 66, 213.

On McGregor's Mountain, limestone of this age is in place as shown on the map. It is grey and blackish, oolitic, full of shells, and overlies conglomerate, while not far off is a hill of diorite and flinty conglomerate, and on the opposite side of the road a knoll of Silurian. That at Finlay McDonald's, near the Vale, is a grey variety which makes good lime: it has been already referred to.

St. Mary's road.

In McLean's Brook, below the St. Mary's road, near the Vale colliery, gypsum is found in a small exposure near the conglomerate, and again on the hill slope west of the brook. It is associated with a grey compact limestone containing shells. The limestone of Park's mills, on Sutherland's River, is grey, veined with calcite and full of characteristic fossils. It is in place, 100 yards north of Park's house, and is undoubtedly identical with that of McLean's Brook, and, perhaps, also of McLaurin's Brook, near the iron mine, as a conglomerate below the falls is the equivalent of the conglomerate of McLean's Brook. This conglomerate indicates an unconformity rather than a fault, the south fault crossing, apparently, further down the river.

Park's mills.

East River.

The best known crops of gypsum and limestone of the East River of Pictou are defined on the map. Perhaps in places they are mixed in the river with rocks of the lower group. Above the bridge at St. Paul's, reddish and grey and rusty, micaceous, soft shale and calcareous, argillaceous sandstone show large impressions of plants. Up stream are grey, ferruginous, flinty, massive, jointed sandstones, succeeded by light bluish-grey limestone, massive or in thick beds, associated with limestone-breccia and shale, veined and blotched with calcite and baryte and succeeded by grey grit and conglomerate. Immediately above the confluence of John McDonald's (Ogg) Brook, are outcrops of whitish and grey marly grit and calc-veined Carboniferous limestone. Below the mouth of this brook, grey limestone with white blotches and veins follows on the strike down the river. A short distance down stream is a greenish and grey crystalline limestone or marble, full of rusty blotches, which may be Carboniferous, altered by some of the adjoining traps, or Devonian. In the bed of the river, near the mouth of the brook from William Grant's Lake, a crumbly, argillaceous limestone, containing shells, is associated with grey, greenish-grey and reddish, coherent, fine, flaggy, calcareous, argillaceous sandstone, often finely ripple-marked, and

Crystalline limestone.

with dark nodular and flaggy limestone, passing into a limestone, full of shells, some of which has been quarried. At the old mill is a band of twenty feet of limestone in horizontal bedding. Nearer the Springville bridge, there are cliffs of red marl, greenish-grey shales and bluish-grey shales and flags, blotched with ferruginous veins and with gash veins of calcspar. Below the mouth of the brook, nearly continuous cliffs of Carboniferous rocks extend to and below the fork of the west branch at Ferrona, the dip being very changeable and the reddish soft sandstones and shales, with greenish and grey bands, resembling those of the lower part of French and Sutherland's Rivers. With them is a band of eight feet of limestone, full of fossils, blackish or grey, somewhat shaly, in part nodular, overlaid by grey calcareous shale and sandstone; and other bands four in number, found lower down, range from one to three feet.

Gypsum of Bridgeville.

Cliffs and mounds of gypsum are found south of Bridgeville. Near the post office is a quarry from which a good mortar limestone has been taken, and other outcrops occur on the lands to the southward. The reddish-grey sandstone and shale on the road to Hopewell, in Centredale, and on the left bank of the East River, between Springville and Bridgeville are perhaps also of this age; but the rocks of Archibald's Brook may belong in part to the conglomerate. Above the road to Archibald's mill, beyond a considerable exposure of red flinty rocks, greenish slate and trap, probably Devonian, is a calcareous conglomerate, with patches of light grey, good Carboniferous limestone, the conglomerate holding pebbles of the flinty rocks; and still higher are immense blocks of grey limestone, which perhaps indicate an outlier among the slates.

Springville.

The limestone of Springville is apparently in several detached patches in the neighbourhood of the Sluice; about Lime Brook, it has been largely quarried and in Campbell Brook is seen to overlie the Silurian above the road. In the little brook from Calder Lake it is associated with bluish-grey sandstone and flags, dipping 224° and containing small impressions of a lamellibranch. In Holmes Brook, the Silurian rocks are in contact with conglomerate and limestone, presenting the following section:—

Contact of Silurian.

| | Feet. | |
|---|---|---|
| 1. Grey limestone, beneath which the water of the brook disappears. Of unknown thickness. [Trans. N.S. Inst. Sc., vol. IV., p. 465, vol., V., p. 202.] | | |
| 2. Rusty-weathering, somewhat crystalline, ferruginous, whitish limestone, with specks of copper pyrites | 15 | Copper ore. |
| 3. Grey limestone, composed of a mass of shells | 2 | |
| 4. Soft soapy conglomerate | 12 | |
| 5. Silurian rocks | .. | |

Near Lime Brook*, outcrops of gypsum and limestone abound. Lists of the fossils of the limestone are given by Sir J. W. Dawson† and Dr. Honeyman‡. It is interstratified with reddish crumbly sandstone, shale and marl, with green blotches; and similar rocks are found in the river above and below the iron bridge; while a short distance down stream, greenish massive sandstone is associated with a conglomerate or breccia composed of Silurian pebbles; down stream from which is a grey, flaggy, massive limestone, with spots of baryte and ferruginous veins, described above.

At the foot of David's Lake are great blocks of Carboniferous conglomerate which probably indicate an outlier in this direction. The contact of the Carboniferous and Silurian follows closely the road from Springville to Churchville, and the various outcrops towards Forbes Lake§ require no special mention. At Churchville the limestone appears to be closely associated with reddish coarse conglomerate. In Robinson Brook, limestone appears near the contact, associated with red sandstone, shale and marl and greenish grey flags, underlaid by the Cambro-Silurian. Below the outlet to Forbes Lake, this brook exposes reddish sandstone; and on the road from the brook to the East River, a limestone, probably fifteen feet thick, usually in thick beds, veined with calcspar and stained with copper ore, is interstratified with reddish sandstone, and has been quarried to some extent.

Copper ore.

West Branch East River.

Above the fork, the west branch of East River shows a few exposures of red sandstone as far as Eureka mills. Here on the shore of the mill-pond a thick band of limestone has been quarried. Above the pond are cliffs of red sandstones and shales, with variable dip, including some grey beds. Above the bridge at Hopewell, for more than two miles the river cuts few rocks, but the banks seem to indicate chiefly red micaceous sandstones and flags, of this age, or Millstone grit, which are exposed as far as Elgin, and also on Fox Brook. Similar rocks are found at Elgin as far as the outcrop of Carboniferous limestone in the west branch. This latter is dark bluish-grey, shaly and thick-bedded, veined with calcspar and at least ten feet thick. Overlying it are reddish and grey soft sandstone and shale. The limestone has also been largely quarried up the Big Brook, where it seems to lie unconformably upon grey sandstones and ferruginous shales, the dip to the south being apparently caused by a fault which seems to separate it from the older rocks. Near the brook, on the road from Lorne to the railway platform, is a shaly and thick-bedded limestone of the usual character; and near the school-house the land is broken by gypsum, as already stated, interstratified with grey and greenish, soft, crumbly shales. Fault.

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* Quarterly Journal Geol. Soc., vol. IV., p. 276; Gilpin's Mines of Nova Scotia, pp. 105, 107.

† Acadian Geol., p. 315.

‡ Trans. N.S. Inst. Sc., vol. V., p. 213.

§ Acadian Geol., p. 317; Trans. N.S. Inst. Sc., vol. III., p. 67.

Lorne. The limestone of Lorne seems to form a tongue in the valley of Big Brook, runs thence across to William Dunbar's quarry, and appears again on the farms of Murray, Halliday and Grant. In the other direction it has been traced to the west branch, to William Ross's, to Macdonald's on the Crockett road, to the Bridgeville post office, thence up the East River. Whitish-grey, rusty-weathering, rough, somewhat soft, brecciated and oolitic limestone is found on the brook which crosses the railway north of Lorne siding. A short distance further west, flinty, whitish, siliceous grit, probably Upper Devonian, is in place.

The rocks of Cameron (Meadows) Brook, for some distance above the river, perhaps belong to this formation, whilst the reddish-grey, fine, coherent sandstone and argillite and impure limestone of the neighbourhood, altered by diorite, and having the joints full of grains of specular iron, are probably Devonian.

Stellarton. On the East River, at Stellarton, the outcrops begin near a tunnel from which a blackish underclay, probably of Millstone grit age, was extracted for brick-making. This underclay and an accompanying dark band are succeeded up stream by grey false-bedded sandstones with a dip of about 30°; these by reddish-grey, crumbly, argillaceous shale and sandstone, which prevail for some distance, and are succeeded by bluish-grey or blackish shales with bands of rusty, nodular ironstone, associated with greenish and grey sandy shales, apparently both overlaid and underlaid by red rocks, including bands of greenish and grey sandstone, on one of which quarries are situated on opposite sides of the river; and, towards the base, with thick layers of nut-and-egg conglomerate. At the bottom of this conglomerate, on the west side of the river, Logan puts the south fault. But a line drawn from this point to the base of a similar conglomerate on the east bank, instead of giving the direction of Logan's fault, runs 137°. These and other questions connected with the Pictou coalfield are now being studied by Mr. Poole. Immediately up stream are rocks which resemble those of Rocklin—reddish, flinty, slaty or prismatic sandstones and argillites, with bright green patches and veins of quartz and ankerite, three inches thick and downward, cut by a dyke of diorite, already South fault. Devonian rocks.

described as Devonian, and succeeded up stream, probably unconformably, by bluish-grey Carboniferous limestone, upon which a quarry has been opened in the bank north of Riverton station.

Waters Brook.

Immediately south of Power's clearing and north of Waters Brook, is an apparently nearly vertical dip of reddish sandstone. Down the brook, reddish, grey and greenish-grey sandstone, pebbly grit and fine conglomerate dip 310° < 40°, and forty paces lower, 342° < 32°. They are succeeded immediately by light grey and rusty, fine, flinty sandstone or quartzite, greenish and reddish amygdaloid, probably Devonian; but lower down, grey, fine, quartzose sandstone, and greenish-grey and reddish, spotted, coarse, pebbly grit, containing carbonized plants, are interstratified in thick beds with reddish fine sandstone, dipping 85° < 30° at Power's quarry. At the Drummond railway these rocks are again seen nearly in contact with the Devonian, from which they are separated by a fault. In a well ten yards north-west of James McDonald's house, a bed of green and grey soft marl, full of fibrous gypsum, was cut; and gypsum is said also to be found on Robert Waters's land in the vicinity. Perhaps the rocks seen north of the north fault on the Drummond railway and at the mouth of Waters's Brook are Lower Carboniferous. North-west of McDonald's is an exposure of spathose rock, apparently ankerite, mixed with a rock probably Devonian.

Fault.

2. *Lime-rock Outlier on the West River of Pictou.*—The limestone quarried at this locality Sir J. W. Dawson compares with the lower limestone of Hants and Colchester*, "containing *Crinoids, Terebratulæ, Fenestella, Corals* and other fossils," particularly in the upper, yellowish, shaly part, which is spotted with crystals of pyrite. It is light and dark bluish-grey, strongly bituminous, veined with calcspar, in both shaly and massive beds. It is evidently an outlier in contact with Devonian and Permian rocks and would seem to indicate not immense incredible changes of conditions of deposition, but rather the faulting which has given rise to the assemblage of so many distinct geological formations in this small district.

A similar outlier of gypsum, marl and limestone is found in the first brook South of Millbrook, about three-quarters of a mile above the Middle River road.

Carboniferous and Devonian.

3. *Outliers in Farnham's Brook, Penny's Mountain and the vicinity.*—Red Devonian argillite is found both up and down stream from an outcrop of greenish marly rock, probably Carboniferous, in the bed of McKenzie Brook, near Philip Archibald's. On the bank, also near

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* Acadian Geol., p. 315.

the flinty rocks, gypsum has been quarried. The funnel-holes at the quarry do not seem to reach below the level of the brook*.

Clifford Brook

Unconformity.

Iron ore.

Limestone quarry.

Carboniferous limestone has been quarried on the left bank of Clifford Brook, the next stream to the westward, below Mr. Hoar's house and not far from a cliff in which the unconformity between this formation and the Devonian is not less well-marked than that between the Devonian and the Triassic. At the point of contact on the right bank, a runlet from the westward has cut its way through the cliff about fifteen feet high into the main stream. Beneath the limestone, which is more or less massive and concretionary, is an irregular bed of egg-conglomerate, composed of pebbles of the red rocks of Union, upon which it immediately rests. On the left bank also is a knoll of red spotted limestone and conglomerate, and immediately east of it, outcrops of grey and reddish, whitish-weathering quartzites, which occupy a considerable breadth of the brook higher up. The dip of the limestone is 107° < 10°, that of the quartzites obscure but probably 172° < 55°, and of those up stream nearly vertical. Cavities in the limestone contain crystalline or botryoidal concretions of calcite and limonite, and in places both it and the underlying slates are stained with hematite. A little higher, doubtful indications of Carboniferous marls are met with, while at the fork of the branch from James Clifford's house, marl and limestone are in the brook, apparently continuous with the gypsum and shelly limestone at the house. Up the west branch, blackish shaly limestone and greenish-white marl are succeeded, immediately above the fork, by slates like those of the iron ore series, cut by veins of ankerite which contain fine specimens of specular iron ore. Higher up, greenish, Carboniferous shale is again present; and near the Telegraph road, dark grey massive limestone, with white veins of calcspar, has been largely quarried; but it is not known to cross the road or to crop on Johnston's farm adjoining.

Farnham's Brook.

Manganese ore.

Succeeding greenish and reddish quartz-veined Devonian slates on the east branch of Farnham's Millbrook, is a cliff of grey brecciated Carboniferous limestone, stained chocolate-brown and indian-red with hematite; and at the contact a large quantity of crystalline pyrolusite has been taken from a shaft. Devonian rocks are seen lower down, succeeded again by red, grey and greenish micaceous shales and gypsum in cliffs; while still lower, dark bluish-grey, flaggy limestone is well exposed in the bed of the brook, separated from the Triassic by a belt of greenish and reddish, shaly argillites, apparently Devonian. In the adjoining branch, a few yards above the fork, light grey, fine, soft sandstone is interstratified with dark bluish-grey limestone, or calcareous flags, containing shells; and good exposures of blackish limestone are found nearly to the back road, the outcrops being, perhaps, continuous with those which extend from Penny's Mountain along the road.

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* Gesner's Geol. of Nova Scotia, p. 132.

Penny's Mountain.

On the top of Penny's Mountain, south of the turn in the road, a large outcrop of Carboniferous limestone forms a hill. It is of various light colours, somewhat dirty, weathers on the surface rusty and indian-red, and is probably the equivalent of that seen in Farnham's Brook. In a branch of this brook, from about the middle of the mountain, are reddish and light greenish-grey shales and marly sandstones. At the eastern end of the mountain a brook on the north side shows black, calcareous, shaly limestone, earthy, and full of brachiopods; but not far distant are the flinty Devonian rocks. From the top of the mountain the limestone does not seem to extend far in any direction, most of the neighbouring brooks exposing the older rocks, upon which both Carboniferous limestone and Triassic are spread in very irregular unconformity.

4. *Basin of Stewiacke and Shubenacadie Rivers.*—Carboniferous limestone occupies the Stewiacke River from its mouth to the top of the settlement at Eastville, where a narrow basin lies between Devonian on the north side and light grey, fine, micaceous, schistose, quartz-veined slates of the gold bearing series of Berry Hill Brook and other brooks of the neighbourhood, a large quantity of drift sand, gravel and boulders often obscuring the contact.

Iron ore of Newton Mills.

The red hematite of Newton Mills is in a contact conglomerate, containing pebbles of whin and other rocks. Cox Brook, in the main branch above the road, shows the gold-bearing rocks in contact with Carboniferous limestone. In the branch which follows the road where it climbs the hill is a conglomerate full of hematite, containing pebbles of the red rocks of Union. At Upper Stewiacke are caves, springs and natural bridges among the great deposits of gypsum and limestone which occur on the north side of the river and towards Pembroke. At Pembroke and Smithfield the limestone contains galena, which has been prospected to some extent at the junction with the older rocks. At Smithfield the limestone is interstratified with reddish, soft marl, including bands of greenish and grey, flaggy, calcareous sandstone, grit and conglomerate.

Caves.

Lead mines.

Unconformity

The boundary between the rocks of Union and this series in Smithfield Brook shows patches of the latter after the first exposures of Devonian, as if to mark a great unconformity. On Otter Brook for a great distance from the river the country is low and occupied by sandstones, shales, gypsum and other rocks of this formation. After crossing the road to Pembroke, one branch displays red Devonian argillites, with associated whitish quartzites, which extend thence to the Pembroke River near the bridge at Sam Deyarmond's, immediately below which a little brook from the westward exposes Carboniferous limestone, apparently at the contact. East of this river, the boundary seems to follow the brook along the road, past the lead mine, to Eastville, and is well shown in several of the little brooks, the conglomerate of the Carboniferous being easily distinguishable from the quartzose grit or conglomerate of the underlying formation. In the little brook which comes into Sam Deyarmond's clearing from the north-east, red and grey, flinty Devonian rocks contain layers of quartzose, pea-and-nut conglomerate, about 300 yards from the house. North of the house for a short distance is a flat piece of land, perhaps indicating Carboniferous rock; and in the brook from the westward, immediately below the bridge on the Riversdale road, are, as already stated, good outcrops of limestone, rubbly pieces of the red rocks being on the left bank, as if the brook here followed the contact. Red Devonian rocks are met with thence along the road as far as Glenbervie mill-dam, where they are well exposed, dipping nearly vertically down stream. Not far from the pond is an outcrop of flinty conglomerate, which has been mined for gold. It is included, between layers of the red rocks of Union, which are succeeded by the grey, greenish-grey and bluish-grey sandstone and shale, rusty-weathering, coherent and rubbly, so well exposed in the large brooks near the school to the northward, and which occupy most of the road to the top of the settlement, some of the dark strata being like those of the road south of Lansdowne. After passing the track to Island Lake, there is a quantity of red argillite and sandstone, belonging probably to the lower part of the Union series.

Supposed auriferous conglomerate.

In the immediate neighbourhood of Stewiacke River, rock exposures are so scarce that it is doubtful whether the grey sandstone and shale of the East Brook are of this age. Immediately south of the road, a seam of coal, said to be eighteen inches of mixed coal and coaly shale, is overlaid by eight feet of dark shale, dipping about 277° < 14° at the openings and also at the outcrops some distance up the brook; while higher still the dip changes to 202° < 19,° the rocks being for the most part red; and, not far up stream, to 127° < 17°. A bed of fine ironstone or impure limestone, a few inches in thickness, then lies nearly horizontal among grey and rusty shales, succeeded further south by alternations of grey and red sandstones

Coal of East Brook.

and shales. A quarter of a mile below the road, grey sandstones dip 281° < 14° ; and at the rocky falls in the river, 167° < 15° ; but both these outcrops are small and somewhat obscure. In Johnston Brook to the eastward, as I am informed by Mr. James Pitblado, a shaft was sunk forty feet and a borehole continued forty feet below the bottom of the shaft. No coal was found but only traces of dirty gypsum. Similar rocks are found between the main river and the south branch, although most of the brooks are sluggish and dirty.

Brookfield quarries.

A large quantity of fossiliferous limestone from the Brookfield quarries is used at Londonderry in the reduction of the iron ores, and from a fine specimen presented to the Provincial Museum in 1887 Dr. Honeyman has described the large species *Nautilus Brookfieldi.*[*]

Short Lake.

Out the road from Brookfield station towards Pleasant Valley, about a mile from the railway-crossing and a short distance past a cutting in red shale, the plain and marsh give place to higher land, broken on the left by pits which probably denote Carboniferous limestone. Past the road on the left to Short Lake, the limestone which has kept parallel with the road, crosses to the right and shows outcrops of shaly and of rough massive limestone, which has been quarried and burnt. On the road to the left towards Green Oak, across the outlet of Short Lake, and again on the road to the left beyond, are exposures of red marl. At Francis Short's farm, immediately past the school-house at Upper Pleasant Valley, gypsum has been quarried and is perhaps continuous with that at Kennedy's a mile and a half nearer Irwin Lake. Grey, reddish, greenish and rusty soft marls and sandstones are interstratified with limestone and gypsum at various points which require no special mention. The principal outcrops are indicated on the map as well as the contact with the Devonian wherever it has been ascertained.

Broken gypsum-land.

Much of the land north of Pleasant Valley is wooded and boggy, and the Cunard Swamp affords a good example of the broken land produced by the outcrops of gypsum which abound at the head of and for some distance down Soley Brook, where they are succeeded by the rocks of Union, which extend to the contact of the Triassic near Cobequid Bay.

Irwin Lake.

On the road to Irwin Lake from the fork of Pleasant Valley road, gypsum is indicated by pits, and quarries and limekilns indicate the presence of limestone as far as the house near the head of the lake, where outcrops of dark grey rusty-weathering slates begin, and nearer the head of the lake have been cut by trenches and small shafts in search of gold. To the northward the debris indicates the red rocks of Union. A brook comes into the head of Irwin Lake from a small lake about a mile out, on the side of which gypsum has been quarried. From the house at the head of the lake a track runs through woods to Beaver Brook settlement at the fork of a road north of Yuill's house, but shows no rocks. In the brook, however, below the bridge immediately past Yuill's house, greenish-grey, flinty, micaceous sandstone or quartzite, with dark grey, slaty argillite, containing threads of quartz a quarter of an inch thick, is associated with whitish, massive, coarse, quartzose grit or fine conglomerate, dipping about 160° < 80°, resembling the rocks which underlie the red rocks of Union, and overlaid by red, soft, hematitic, marly, Carboniferous limestone.

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[*] Trans. N.S. Inst. Sc., vol. VIII., p. 13.

Search for gold.

Northward from the fork of this road, along the main road through Beaver Brook settlement, the land is flat; and at 595 yards a small brook exposes five feet of bluish-grey bituminous limestone, dipping 237° < 17° in a quarry, a few yards above which the Devonian rocks begin. Further north, other points of contact are found; and the boundary has been traced round to the brooks of Clifton, in which the red rocks of Union are well exposed beneath the Triassic. At the saw-mill in Irwin Brook, they dip 299° < 40°, their contact with the Triassic being immediately opposite a fork of the road lower down.

Devonian and Triassic rocks.

About 500 yards below the fork of Beaver Brook road, and the post road, on the left bank of a little brook from 270°, are two shafts, twenty-three yards apart, which have cut the red Devonian rocks and from which a considerable quantity of limonite has been taken. It occurs in small veins or concretions. One of the shafts is said to be seventy feet deep and to have cut a white sandstone in the bottom.

Clifton iron mine.

Along the post road, west of the Beaver Brook road, a red hematite has been dug for paint, and beyond it are outcrops of the rocks of Union. It is doubtful whether the limestone and gypsum formation appears again between this point and Blackrock, where large exposures of dark, shaly Carboniferous limestone, containing spots of pyrolusite and hematite and white veins of calcspar, dip south-westerly into the Shubenacadie River, and are succeeded up the river by cliffs of red marl and sandstone, gypsum, limestone and other strata of this formation, described by Mr. Gilpin*, and Sir J. W. Dawson.† At Anthony's Nose, a limestone about forty feet

Blackrock.

Shubenacadie River.

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* Trans. Roy. Soc. Can., p. 159.

† Acadian Geol., p. 266.

thick, which is a mass of corals and shells, "stands quite on edge, projecting like a huge wall into the river. Soft marls rest against each side and include a bed of gypsum, and, at a little distance, a thick bed of this mineral appears with an arched stratification. On the opposite side of the river there are other limestones and gypsums, also very much disturbed; and, immediately adjoining them on the south, there is a cliff of nearly horizontal reddish sandstone, like that of Eagle's Nest."* The banks of the river are rocky by turns, and rocks of this formation are seen on most of the roads of the vicinity as well as on those towards Pleasant Valley and Brookfield. At Green Creek, red and green and grey soft marl, with limestone and gypsum, are found lying at a low angle.

Down the west side of the river, between Shubenacadie railway station and Maitland, none of the land is high, although occasionally hilly, and some of it is wet and barren. Outcrops of gypsum and limestone are met with along the streams, but are still better exposed in the banks of the river. West of Maitland, Triassic rocks skirt the shore for some distance; but on the western edge of a large piece of dyke land past Selmah Creek, and not far below the shore-road, irregular, and nearly vertical beds of reddish, greenish and grey, coarse, flinty grit, probably Devonian, have been quarried for rough building stone. Above the road, in Sterling Creek, however, is a large quantity of grey and red marl, probably associated with the gypsum exported at one time from this locality.

South shore of Minas Basin.

From Sterling Creek the coast is low, with a few headlands of Triassic rock, to Mungo Creek, where, between the bridge and the shore, the Triassic includes several beds of very coarse conglomerate. It follows in high cliffs to the westward and up King Creek to a mill. No Carboniferous limestone rocks appear on the shore to the westward, except in small patches, as at Walton, Cheverie, and Summerville, either the Triassic or Devonian strata occupying the coast; but a short distance inland and over a great part of the country between the shore and Kennetcook River, the gypsum, limestone and associated strata occur; and at their contact with the older rocks are found ores of manganese and iron.

Outliers among Devonian and Trias.

Noel to Kennetcook.

The road from Noel to Kennetcook runs south up the east side of a large brook which shows, at a fall and shingle mill, about half a mile from the corner, fine outcrops of grey, micaceous, flinty flags and sandstones, with rusty spots, and plants probably Devonian

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*Op. cit., p. 268.

These dip up stream at a low angle and are associated with wavy, micaceous, somewhat massive sandstone and light grey flinty grit, many of the strata resembling those of the Tenecape manganese mine. But a short distance north of the outlet of a long lake, the soil is rusty and sandy, perhaps denoting Carboniferous limestone and gypsum, which occur on the east side of the lake. Immediately south of the fork of the roads at this point, about fifty yards south of the house of Mr. John Hennigar, and 100 yards west of the road, a pit dug in search of manganese ore cut a reddish and grey rock, full of calcspar veins with threads and specks of pyrolusite, and a red soft sandstone, probably Carboniferous; and in the immediate vicinity are outcrops of limestone and gypsum. South from Hennigar's, blocks of grey, soft, flaggy sandstone and of dark marly rocks indicate this formation as far as Captain Scott's, about four miles from Kennetcook River, where limestone is exposed; and probably also as far as the river. Out the road to the Gore the land is bouldery with blocks of grey granite or syenite, covered with spruce, tamarack and birch second-growth or small clearings, for some distance. Then coarse, rusty sand and pieces of soft, flaggy, coarse and fine sandstone and pebbly grit, composed almost wholly of quartz, no doubt indicate the country-rocks, which are seen on the hill, succeeded by black, papery, micaceous, rusty-weathering, coaly shales and argillaceous shales with rootlets; succeeded in turn by the greenish and light grey, chloritic and micaceous, pearly and soapy, striped slates of the gold-bearing series, upon which also is situated the Gore antimony mine.

Manganese ore.

Gore.

Contact of Cambrian.

Several miles higher up Kennetcook River, in a large brook from the southward immediately below Mrs. O'Brien's, grey fine sandstone near the bridge dips 337° < 30°, and a little higher < 10°; while not far below an old saw-mill, above which gypsum has been quarried, grey soft sandstone, shale and limestone dip 0° < 30°; and in this vicinity search was made for coal.* Near the mouth of this brook, an opening was made from the road in black carbonaceous shale, containing small traces of coal, and on the opposite side of the road are several pits in one of which streaks of bright clean coal, one inch thick and downward, are exposed, and also, it is said, a seam one foot thick. Gypsum and limestone underlie it at no great distance. On the north side of Kennetcook River, immediately below the shop and house of Mr. Nelson Weir, the best of these small coal seams was opened in several shallow pits on opposite sides of the

Coal seams.

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*Acadian Geol., pp. 268 and 276.

river; but it appears to have been only a few inches in thickness and an extension of the coal seen both up and down the river. The strike is easterly, the dip doubtful. In a brook from the northward, not far above Mrs. O'Brien's, grey, fine, soft, shaly, flaggy and thick bedded sandstones dip 192° < 18°, so that the width of this basin is apparently not great; but whether limestone and gypsum overlie as well as underlie, was not determined.

Elmsdale.

On the road west from Shubenecadie station to Indian road and Bar settlement, rocks of this formation are everywhere in place nearly to the Gore; and on the road down Nine-Mile River to Elmsdale, their contact with the auriferous series is frequently seen.

Debert River.

5. *Outliers of the north side of Minas Basin.*—The limestone and gypsum, red soft sandstones and shales which come from beneath the Triassic of Debert River, not far from its mouth, are described by Dr. Ells* and Sir J. W. Dawson.† For a great distance to the westward, no rocks clearly of this age appear between the shore and the Devonian of the mountain, but at Clarke's Head‡ "beds of common gypsum and a beautiful purple variety of anhydrite" occur faulted with strata of the underlying formation; and similar patches are found between this point and Port Greville, the unconformable superposition of the basal beds upon the underlying slates being well marked at several places.

Clarke's Head

Shore east of Spencer's Island.

Between the mouth of the brook east of Spencer's Island post office and Mahoney Brook only drift is seen on the shore. Then red marl and sandstone, shattered, rubbly and slickensided in part, are interstratified with bands of greenish-grey conglomerate, grit and sandstone, dipping inland at a high angle and extending to Fowler Brook, where they have an easterly dip, at first very high but decreasing to the eastward and covered again by drift. In the landwash at the brook next west of Phinney Brook is a patch of very soft bright red sandstone, greenish conglomerate and greenish soft marl, perhaps Triassic, with a low variable dip seaward and westward, and a band of grey limestone at the base, which breaks into large nodular blocks. At Phinney Brook, Devonian rocks begin and the outcrops of Carboniferous are interrupted as far as Fox River, from which, however, they extend east in cliffs and reefs nearly to Parrsboro' pier. Near the mouth of Fox River they consist of red shales or marls, with green spots and layers, interstratified with grey, fine-grained flaggy sandstone, wavy and false-bedded, containing

Trias and Devonian.

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*An. Rep. Geol. Surv., 1885, vol. I., Part E, p. 42.

†Acadian Geol., p. 100.

‡Acadian Geol., pp. 105 and 265.

rusty patches full of broken carbonized plants. They greatly resemble millstone grit and the dip would appear to place them, if there is no dislocation, above the rocks of Bull's Bluff and the dark shales and red and whitish, more flinty and broken strata east of Cape Sharp. Between Ramshead and Diligence Rivers, grey sandstones and red marls are finely exposed and probably occupy also the flat land between the shore and the foot of the mountain above the post-road, which extends also towards Parrsboro' with a ridge on the south side.

Diligence River.

Up the left or east bank of Diligence River for some distance, rusty and coarse sandstones and rough flags, one of which has a surface of ten feet by six feet and is a foot thick, are interstratified with red and grey shales, like those of Cape Sharp; then tidal marshes prevail. South of the river, the shore exposes a great thickness of reddish and grey, fine, flaggy, wavy, somewhat coherent sandstones and shales, the former very full of carbonized plants. Near Bull's Bluff are two bands of black bituminous shale, one six inches, the other two feet thick, and a coal seam an inch thick. From Bull's Bluff, these rocks, dipping inland, strike along the shore as far as the Triassic trap and sandstone of Cape Sharp, immediately beyond which, however, they are again well exposed to within half a mile of the Triassic of Partridge Island. A close and accurate survey of these shores was made by Mr. Barlow. Immediately east of Cape Sharp a few blocks of limestone were found on the beach. The marls here dip easterly at a very high angle, are chiefly red but include bands of hard grey sandstone, with two inches of coaly matter and a band of coaly bituminous shale, two feet thick, full of *Naiadites* and other fossils. Then for some distance, sandstones and marls chiefly dark-greenish or grey but also red, containing a few small veins of calcite and ankerite, dip inland and undulate, showing good examples of contorted and faulted strata, some of which have been broken without displacing the beds above and below. About fifty chains northwest of the north end of the gravel beach at Partridge Island, these rocks are underlaid by grey and red conglomerate, associated with grey sandstone and with limestone; and, about a quarter of a mile from the beach, resting directly upon Devonian slates which dip 153° < 76°, whereas the dip of the conglomerate and associated red sandstone is 284° < 18°. The conglomerate is exposed for only twenty-five paces west of the contact; then comes an interval in which a road goes up from the beach, then a little brook shows red crumbly marl, which continues along the coast to an outcrop of black bituminous limestone, full of shells, succeeded by massive limestone; that by red conglomerate overlaid by grey conglomerate and sandstone,

Coal and black shale.

Cape Sharp.

Contorted strata.

Unconformity near Partridge Island with Devonian.

Fossiliferous limestone.

flaggy and full of broken plants; overlaid by red conglomerate and marl and by grey, thick-bedded, jointed sandstone, with rusty streaks, large carbonized plants and patches of dark shale. From the first band of grey sandstone to the second is about 200 paces. About 130 further, at a little brook, the dip is easterly; about 250 further at a larger brook, red conglomerate is again exposed, with a westerly dip and overlaid by the rocks described above.

Unconformity at Parrsboro' River.

Swan Creek outlier.

At a point on the east side of Parrsboro' River, lying 121° from the lighthouse, another contact of these two series is to be seen in the cliffs, the conglomerate dipping 282° < 22°, the Devonian, a few feet from the contact, 165° < 83°. The conglomerate is red; its pebbles plainly derived from the underlying flinty rocks, every variety of which is represented, range in size from that of a nut to more than a foot in diameter; it contains lenticular layers of greenish-grey flaggy sandstone, full of comminuted carbonized plants, and is overlaid by reddish shale and flaggy sandstone, with green blotches and spots, which are exposed northward to the mouth of a large tidal brook. On the road at this brook, reddish, soft, marly shales, with greenish bands, dip 18° < 51°. Three-quarters of a mile to the eastward are indications of indian-red Carboniferous marl, and about a quarter of a mile further, of greenish gypseous marl, in the road at a house; whereas immediately above the road, and also below it to the eastward in a brook, the flinty rocks of the iron ore series are exposed and on the shore road eastward to Swan Creek, dark shales and flags. In Swan Creek, a conglomerate outlier, similar to the above, lies among the Devonian near the road. It is indian-red and contains many large pebbles of the whitish quartzite, with which it is undoubtedly unconformable. On the shore between Parrsboro' River and Swan Creek are several outcrops of Carboniferous rocks upon the Devonian.

Wasson's Bluff.

Triassic trap.

Clarke's Head

With the exception of one small patch of Triassic conglomerate, of which an area of only ten feet square is exposed, the little brook east of Wasson's is occupied, from the road to the shore, by the red rocks of Union. Immediately to the westward, however, cliffs of trap-conglomerate or globular trap begin, and, in alternations with red Triassic sandstone, occupy all the shore round Swan Cove to the gypsum and limestone of Clarke's (Fraser's) Head, large blocks of the trap being apparently completely surrounded by Triassic sandstone. In contact with the trap on the south side, seven paces north of a fish-house, are soft green and red and blackish gypseous marls, with veins and masses of rose-coloured and white gypsum, succeeded by flaggy layers of calcareous rock or limestone, dipping 9° < 70°, succeeded by a light greenish and rusty sandstone and dark and light soft marl, dipping 352° < 80°, faulted, and succeeded by gypseous marl, containing masses of gypsum, and by limestone veined with calcspar. At 133 paces from the first outcrop the strike is 170°. At fifty further a mass of gypsum carries specks and aggregations of pyrite; it strikes 173° for 241 paces further, then turns at right angles to the westward, a high cliff of purple and greenish slates towering above it along a fault. Devonian slates and flinty sandstones, with veins of ankerite sometimes two inches thick, here dip 22° < 42°; but thirty paces further, 119° < 50°. The shore turning due west from the Head shows little patches of soft marl and gypsum at 130, 430 and 540 paces, the unconformity of the last being plain; at 900, the granular felsite or diorite of a pinnacle rock has close to it gypseous marls and sandstone, quite unaltered; while through them stick little bosses of the purple and rusty and dark slates, marked with plants, greenish flinty sandstone or quartzite, veined with ankerite, precisely like the country-rock at Londonderry mines, and dipping 200° < 45°. One of the veins of ankerite is six inches thick. At 1380, soft marl lies upon the slates; and at 1,750 rusty Carboniferous sandstone and conglomerate, containing much calcspar are succeeded by whitish and dark limestone and gypseous marl; followed at 1,830 by Triassic trap and sandstone, which extend to the brooks in the cove mentioned above as showing the Devonian near the contact of the Carboniferous. Between this brook and the conglomerate are outcrops of dark gypseous marl, with layers of brecciated black crystalline limestone, of purple, red and green Devonian rocks, with a large proportion of dark beds.

Dyke.

Iron ore.

On the west side of the harbour between Parrsboro' and the coal-loading ground at Whitehall Creek are flinty sandstones or quartzites of somewhat doubtful age. Across this creek and that south of it dark shales are well exposed. Then the lighthouse point and a large salt marsh intervene. On Crane Point red and green, flinty, Devonian slates, jointed into rectangular and triangular blocks, and veined with ankerite, underlie a considerable thickness of dark grey and green and grey sandstone and shale. Then towards the pier the red rocks come on the coast, as shown on Mr. Barlow's map, as well as the red and grey rippled flags, underlaid by dark shales and flags, like those of Horton Bluff, containing layers of limestone, of fine calcareous grit and of blackish rock, full of broken plants, upon which rests the conglomerate west of the pier.

Parrsboro'.

Up the large brook quarter of a mile south-west of Parrsboro' railway station, immediately above the road, are dark shales which have been dug, and grey sandstone in thick and flaggy beds, probably Carboniferous, dipping 341° < 70°. Above these outcrops none occur as far as the large alder-marsh, but on the south side of the brook is a ridge or terrace of low hummocky land, its top showing gravel, its base blocks of grey compact sandstone. Above the marsh, light grey fine sandstone and dirty greenish-grey, crumbly, argillaceous shale, dip 300° < 40°; and higher up 335° < 30°, in barren land not far north of the Blackrock road.

Northumberland Strait.

The outcrops of this formation on the shore of Northumberland Strait, between Wallace Harbour and Saddle Island, are apparently the lowest beds of a sharp anticlinal or a great fault which passes between Saddle Island and the mainland. They appear first immediately west of the marshy sand-flats at a lobster factory west of Treen Bluff, and consist of blackish-grey somewhat brecciated limestone, whitish gypsum and dark marl, striking 234° with a nearly vertical dip; interstratified with grey and greenish rusty-weathering sandstone, full of carbonized plants mineralized with black crystalline spar, and containing small veins and blotches of albertite, black spathic iron and calcite. Apparently overlying these unconformably* at a small brook, are reddish pebbly grit and conglomerate, probably Permian, like the cliffs of Cape Malagash and the shores of Tatamagouche Bay. Fine exposures of plaster occur on the inner shore of Wallace Harbour, as stated by Dr. Ells.

### G. 2.—Millstone Grit.

Rocks of this formation, as they occur at Merigomish, have been already described†; and it has also been stated that certain areas included among the lower formations may belong to this, the great faults and unconformities of the district, and the uncertain value of the evidence of fossil plants having left obscure the relation of the various groups, even in the immediate neighbourhood of the coal measures. At the base, at Merigomish, Sutherland's River, the Vale colliery and McLeod's Brook, is a conglomerate not unlike that described as occurring to the eastward and perhaps its equivalent.

Merigomish.

In the little brooks near the railway station of West Merigomish, reddish and grey soft sandstone, with conglomeratic and concretionary patches, is interstratified with marls like those on the banks of Sutherland's River. The grey flaggy beds are blackened by carbonized plants, and certain layers have been quarried. The age of the outcrops of conglomerate and greatly broken, red, micaceous sandstone along the fault near the iron mine at McLaurin's is, as already stated, doubtful.

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*An. Rep. Geol. Surv., 1885, vol. I., Part E, p. 41.

†An. Rep. Geol. Surv., 1886, vol. I., Part P, p. 86.

Some of the grey sandstones, containing impressions of ferns, *Calamites* and other plants, traces of impure coal and black shale, found in thick beds and in flags along the contact of the Pre-Carboniferous rocks on the St. Mary's road and other roads in the vicinity, such as McLellan's Mountain road, are perhaps of this age or higher. The red sandstones and shales of the railway west of French River contain large nodules of grey fossiliferous sandstone and are similar to reddish sandstones, with bands of grey, found in the neighbourhood of Glenfalloch.

East River Pictou.

The rocks of the East River at Stellarton have already been described. In the rocky land between the head of the McKay Brook and McNaughton's mill on McCulloch's Brook, thence out the old road to the Westville road, are blocks and a few outcrops of a reddish sandstone similar to that of Stellarton and probably of the same age, a large area of rock north of the south fault being referrible to this rather than to the coal measures. The reddish somewhat coherent and greenish-grey and grey beds on the road north towards the Drummond colliery, and also south to the Foxbrook school, exposed in several brooks of the neighbourhood, are perhaps Lower Carboniferous.

Foxbrook.

Near the Foxbrook school, at Finlay's, a band of calcareous concretionary or conglomeratic rock was supposed to be a limestone and an attempt was made to burn it. Some of the reddish and grey, flaggy, fine sandstones in the immediate neighbourhood of the school are flinty and rubbly as if influenced by a fault. They extend through to the Middle River road and on the road turning to the left about a mile past the school. At the Whitehill road here, a brook shows reddish micaceous sandstone, but a short distance down stream, where it turns away from the road, reddish, very rubbly rocks, include bands of sparkling, quartzose sandstone or quartzite, resembling the Devonian of Rocklin. Lower down are others, lying at a moderate angle yet as rubbly as any of the rocks of Riversdale or Loch Lomond, generally red, but including layers of grey flinty sandstone; these extend to the head of the mill-pond. At the bridge are small veins of pyritous calcspar. But almost immediately below the mouth of this brook the Middle River shows grey sandstones, which have been quarried near the bridge at Union Centre, and include layers of concretionary limestone-conglomerate, a few feet above and below the bridge and supposed by Mr. H. S. Poole to be Lower Carboniferous. And from this point, red soft rocks, with bands of greenish limestone-conglomerate

Doubtful Devonian rocks.

and of red and grey, mottled, argillaceous sandstone, like that seen on the road from the Black Diamond colliery to McLeod's Brook, are well seen in the river and on the roads of the neighbourhood, including, about 350 yards above the mouth of McLeod's Brook, a small seam of dirty coal. The rocks seen where the railway leaves the road west of Hopewell, are red, soft, flaggy Carboniferous strata, probably millstone grit. Those in Cameron (Meadows) Brook where it approaches the railway, are similar, as well as those seen in the main branch above the railway and in a cutting west of it. But about 250 yards from the brook is a large block of the dioritic rock so characteristic of this region, which, if in place, indicates the Devonian, a supposition which is strengthened by the next outcrops. And the steep dip of the red rocks seems to indicate a great fault.

Hopewell.

Middle River.

At the west end of the Foxbrook road the rocks resemble those of the Black Teeth of East River, being chiefly argillaceous, with hard bands and a layer of green concretionary limestone-conglomerate. Near the river road the dip is 80° < 80°. On the Crockett road near the limestone are reddish-grey Carboniferous sandstones like those of Hopewell and Foxbrook, associated with bands of concretionary, calcareous conglomerate. No limestone is seen between the outcrop at Crockett's and the quarry at John McDonald's. The rocky ridge of reddish sandstone perhaps cuts off this limestone by a fault or overlaps it both here and between Finlay's and Grant's. The adjoining rocks are almost certainly Devonian. The green shale is very characteristic, and the black shale of Jessie Grant's is perhaps that of the Cross Brook and Archibald's Brook, of West River and of Riversdale.

McLeod's Brook.

Returning to the Middle River, the rocks of McLeod's Brook* are like those of the East River above the west branch, and seem to dip uniformly down stream. They are reddish shales and sandstones, associated up stream with bands of greenish and grey, rusty-weathering sandstone, with pebbly patches. Below the dam at the road a quarry has been opened on a thick bedded, reddish-grey and grey, fine sandstone. At the dam a thick band of nut-and-egg conglomerate is seen, and similar rocks extend to and beyond Oliver's mill.

McCulloch's Brook.

In McCulloch's Brook, a patch of reddish and greenish, micaceous Carboniferous sandstone, which occurs among the Devonian and Permian strata near the Drummond railway, and includes a band of dark grey limestone, is perhaps, like the gypsum of Waters' Hill,

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*Geol. Surv., Prog. Rep. for 1866-69, p. 60.

Fraser Brook and the neighbourhood, to be included rather with the underlying formation than with the millstone grit. It is not shown on Logan's map, although the Carboniferous area, a short distance higher, is indicated.

Coal measures

The grey sandstones in Middle River at the mouth of McCulloch's Brook, seem to be coal measures rather than millstone grit. They are for the most part of fine grain, with greenish layers and bands of red and green argillite, ripple-marked and flaggy; and continue in cliffs to the mouth of French's tunnel, from which a large quantity of coal was extracted from a seam supposed to represent one of the workable coals further east. It is underlaid by a rusty, pyritous underclay, and in the river there are reddish argillaceous rocks, with a dark bituminous layer three feet thick, underlaid by calcareous concretionary underclay, perhaps representing the coaly rocks of the tunnel. Grey strata and bands of nut-and-egg conglomerate, and of concretionary grit, occur higher up; but most of the rocks consist of red sandstone and shale, which are well exposed in cliffs. They are succeeded near Union Centre by broken faulted rocks which have been described as Devonian.

Devonian.

Union Centre.

The red sandstones and marls west of Burnside and Union Centre are perhaps of this age, the high angles of the dip no doubt indicating faults. Their contact with the flinty series is still somewhat uncertain in places.

Debert.

As already stated, it is possible that the strata of Debert* and Chiganois Rivers, described as Lower Carboniferous, may be in part at least of this age.

### G. 3.—Coal Measures.

Limits of coal measures.

The true or productive coal measures are confined to the area determined by Sir William Logan and Mr. Hartley, in their report of 1869 on the Pictou coalfield. The limits as defined by them remain practically unchanged, but "recent mining operations, borings made by Mr. R. P. Fraser, of Pictou, with the diamond drill for certain mining companies, and geological explorations made by the late Mr. Jesse Hoyt and Mr. H. S. Poole for the Acadia Coal Mining Company, have added many facts necessary for understanding the complicated structure of this field," and some alterations and additions are now consequently required in their map. Some of these are indicated by Mr. Gilpin,† and all of them have been

Changes in map of 1869.

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*Trans. N. S. Inst. Sc., vol. VI., p. 93.

†Trans. N. S. Inst. Sc., vol. VI., p. 90; Trans. Roy. Soc. Canada, vol. I., Sec. IV., p. 137; vol. V., Sec. IV., pp. 25-30.

McCulloch's Brook fault.

worked out in detail by Mr. Poole.* As already stated, a narrow belt included with the coal measures on both sides of the East River, along the southern edge of the field, and east of McCulloch's Brook fault, is now regarded as millstone grit, whereas the rocks of French's tunnel appear to be coal measures. This fault is of much more importance‡ than is assigned to it, and the Acadia mine so-called basin, instead of being only 800 feet deep, is more than 1,600 feet, and the fault 2,600 feet.

McLeod fault.

The evidence seems to be insufficient upon which the McLeod fault and other minor faults of the district have been drawn. Mr. Poole believes that the former is of trifling importance, and that the continued deterioration of the seams at the east end of the basin—so marked at Grant's slope on the East River and at the Pictou Company's shaft—has produced such a change of thickness and quality that the McLeod seam of less than eight feet represents the Albion main seam of nearly forty feet in thickness, as would seem to be proved by the large quantity of black shale overlying both. A bore-hole was sunk sixty feet at the bottom of the McLeod pit, but no coal found. There is no evidence of this fault on the railway, where it is shown by Hartley. In the railway cuttings, on the contrary, the northerly dip of the Albion mines measures is retained nearly to the McCulloch's Brook fault, where it changes to west, a dip also seen among the red sandstones at the great turn of the Drummond railway, and probably due to this fault. All the faults of the workings on the main seam are north and south faults with, west of English church downthrows to the west, and to the east on the east side of the church; and it seems not improbable that the McLeod fault is one of these. To the westward of the McLeod pit, red rocks are said to have been cut which perhaps indicate the millstone grit or termination of the coal measures, which is also found in a boring at the Nova Scotia or Black Diamond Company's slope. Mr. McBean found the coal south of the pit. North of the pit it seems to have been lost at a north-and-south fault. A number of little faults and consequent derangements of the dip, the paucity of exposures and their small extent, render the precise description of the structure still obscure.

Another east-and-west fault shown on the map appears to be a combination of the Stair-pit and Dalhousie faults inaccurately represented.

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*Trans. Amer. Inst. of Mining Eng., vol. XIV., p. 403.

‡Trans. N. S. Inst. Sc., vol. VII., p. 391.

West fault.

Instead of the west fault there appear to be, according to Mr. Poole, small faults on the flank of a hill of Devonian rock at Highfield farm near Westville. The main seam at the Acadia mine is eighteen feet thick, while at the Black Diamond it is eight feet, the bottom benches having turned into stone. And it is supposed by many that, by a further deterioration, the main seam becomes the dirty seam of French's tunnel.

Mill-road fault.

The Mill-road fault also, from close investigations made along the supposed course by pits, appears to be of little importance. Sir William Logan states that it cannot be traced north of Black's mill-site, and at the mill-site the displacement by a number of little faults seems to be of little moment. Above the mill-site at a great turn in McLellan's Brook, is a slight fold of the sandstone which gives rise to two small basins and a slight squeeze or dislocation in a distance of 150 yards east and west, the dip going round in one place from 114° to 157°. Lower down, about twenty yards above the old mill-site, is a curious disturbance, which appears to be only local, as if a small piece in the bed of the river has been thrust on edge, whereas on the left bank the measures are undisturbed.

Changes in the coal and strata.

Changes as great as those described above take place in the character of the coal and of the strata associated with the coal at the Vale. Conglomerate in one place replaces a fireclay and in another the shale above the seam becomes a massive rock. The coal seams deteriorate in going south towards the mountain, and where dipping east or south they are said to be seldom, except in the case of the Captain seam, of such good quality as where dipping away from the east and south faults. The St. Lawrence pit is supposed to be on the eight foot seam of the Vale. The supposition on page 41 of Logan's Report that the Widow McLean seams underlie the McBean seam has since been proved to be erroneous. The eight foot or McBean seam represents the eight foot nine inches or Widow McLean seam, somewhat disturbed by faults; and the McBean and other seams have been traced by Messrs. Barton, Mitchell and McBean to the east fault. The contact of the different series near Donald McLean's south of the Vale—of the coal measures, gypsiferous series and Cambro-Silurian—is shown on the map.

McBean seam.

George McKay seam.

From the George McKay slope a considerable quantity of coal has lately been taken by Mr. Muir from a seam about four feet three inches thick. It is said to be an excellent house coal, easy to work, and is largely sold in Truro. Recent explorations render it doubtful whether Sir William Logan was right in identifying the McKay seam as the six feet seam and in separating the latter from the Mountain seam. The four feet seam, of page 35, line 10 of his report, is said by McBean to be only two feet, and he supposes it to represent the ten inches of coal lying above the oil shale.

Potter's Brook fault.

From the Foord pit, levels have been extended a considerable distance east of the East River, and in the opposite direction round the end of a basin, across the supposed position of the Potter's Brook fault and to the high angle of the north rise. Instead of this fault there are here a great number of trifling north and south faults. On this north side of the basin, at Dan Tupper's on the Truro road, a coal seam has been worked, which is supposed by many to be the main seam but is perhaps rather a seam overlying that at some distance. The age of the rocks north of the Truro road at this point is a disputed question. They strongly resemble the Permian grey sandstone of the East River, north of the New Glasgow conglomerate; and their dip at Fraser's quarry is north at a very low angle.

North fault.

The north fault has been shown as crossing McCulloch's Brook a quarter of a mile north of its actual crossing, and, as already stated, the size of the Devonian area of this corner of the map is greatly exaggerated, the rocks in and south of Waters' Brook between Waters' quarry and the railway being millstone grit or Lower Carboniferous, and several large patches in McCulloch's Brook and Middle River, shown as Devonian, being New Glasgow conglomerate.

The rocks of the little branch of McLeod's Brook, between it and the Nova Scotia colliery, along which the road now follows, consist of grey, coarse, rusty-weathering sandstone, associated with one seam of dirty coal. Below the bridge are reddish-grey, fine, soft, marly sandstone and spotted concretionary, reddish-grey sandstone, probably the upper beds of the millstone grit, unless a fault intervenes, of which there seems to be no evidence.

### G. 4.—PERMIAN.

Subdivisions.

Rocks of this age as displayed between Merigomish and Pictou and along the north side of the Pictou coalfield, have been already described.* They may be subdivided as follows:—

1. New Glasgow conglomerate.
2. Middle grey sandstone and shale group, with small coal seams.
3. Upper red sandstone and shale group, with thin bands of limestone.

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*An. Rep. Geol. Surv., 1886, vol. II., Part P, p. 93.

Distribution.

These groups lie in parallel belts along the shore of Northumberland Strait between Merigomish and Wallace,* dipping seaward, generally at a low angle, but broken by faults sometimes of considerable magnitude. Between the second and third groups there is no distinct line of demarcation and the subdivision is only one of convenience.

### 1.—New Glasgow Conglomerate.

Although rocks of the lowest of these subdivisions occupy a belt from five to two miles wide between Fitzpatrick Mountain and Waugh River, they are entirely absent at Bailey's Bridge, one mile and a half west of Waugh River, owing either to a fault or to unconformity, the grey and brown sandstones coming upon the Pre-Carboniferous rocks of Tatamagouche Mountain. The other groups are everywhere present, exhibiting more or less persistence in their composition and appearance until traced into connection with the large areas in Cumberland county.

Evidence of age.

The outcrops of the conglomerate between Merigomish and the Middle River of Pictou, between Alma and Granton, have been fully described. At the Middle River, they are broken apparently by a great north-and-south fault, and on the west side of Greenhill by another, beyond which they reappear in Fitzpatrick Mountain and are continuous to Waugh River. Considering that the conglomerate at New Glasgow and elsewhere contains pebbles and blocks of grey sandstone which are as likely to have been derived from the coal measures as from the millstone grit (which here contains far more red beds than grey); that the millstone grit has not been proved unconformable to the coal measures, but seems rather to pass upwards into them, the presumption is strong that the New Glasgow conglomerate is newer than the coal measures, as assumed in last report, the absence of fragments of coal from such coarse conglomerates counting for nothing,† as a larger proportion of pebbles of syenite and diorite and of Devonian and Silurian slates is present in all the conglomerates. A hole 734 feet deep, bored on the south side of Sutherland Point, below New Glasgow, in search of coal, on the assumption that the coal measures were there concealed by an unconformable overlap of the Permian, seems rather to add weight to the supposition that the conglomerate is a basal portion of the Permian, a conclusion at which, I am informed by Mr. McBean, Sir William Logan arrived

New Glasgow Borehole.

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*Acadian Geol., p. 129.

†Trans. N. S. Inst. Sc., vol. VII., p. 202.

upon a re-examination of part of the coalfield subsequent to the publication of his report. The borehole seems to have cut only strata similar to those naturally exposed on Smelt Brook and on the river.

Fault.

At New Glasgow on the old Merigomish road, and south of it, about a-quarter of a mile from the bridge on the river, the conglomerate strikes 64°, vertically or with a steep dip to the south. Perhaps this is the fault mentioned by Mr. Poole.* The last outcrop is near the fork about 200 yards east of Church's livery stable. A steep dip is also seen on the left bank of East River, above the bridge. Perhaps both are due to the proximity of the north fault, which must be in that case subsequent to the deposition of the conglomerate, as are others in the neighbourhood of the Middle River.

Unconformity

Along Blackwood's millbrook, however, which, as described by Mr. Hartley, is the unconformable boundary between the conglomerate and millstone grit for some distance to the westward, the dip of the former is not so steep. The dip of the millstone grit in the first little tributary from the south, about 250 yards from the river road, is $29^\circ < 62^\circ$, while the general dip of the conglomerate is much more northerly. Nearer the old quarry road, the millstone grit dips $44^\circ < 66^\circ$, and still nearer, reddish harsh shales of the same age dip $51^\circ < 66^\circ$. On the south side of the road at the bridge on this tributary, underclay and coal indicate the measures of the south side of the great north fault. The direct superposition of these rocks is seen in this brook at the dam forty yards above the bridge on the East River and twenty yards north of the old quarry road, showing very clearly the unconformity between the two groups. Grey sandstone, with greenish and reddish tints, dipping $42^\circ < 51^\circ$, is overlaid by thick beds of very coarse conglomerate which fills depressions in the lower beds. These are not perhaps, however, necessarily higher than the Carboniferous limestone, patches of which are found on Waters's Hill, although included with the millstone grit by Mr. Hartley.

Coal and limestone

The limestone associated with the seam of coal which overlies the conglomerate at James Small's and William Fraser's (Moose) is said by Mr. Fraser to have been struck in a boring on Middle River, near Sylvester station, and to be there twenty feet thick. In Small's Brook the rocks of this horizon are well exposed, consisting of underclay, coaly shale and botryoidal limestone, but no pure coal seems to have been obtained. The dark layers are perhaps equivalent to those of the Smelt Brook described by Mr. H. Poole. According to Mr. Fraser, the coal and limestone come to the East

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*Trans. N.S. Inst. Sc., vol. I., p. 37.

River a little below the cemetery. To the westward they do not seem to have been satisfactorily traced, although the dark layers of Rear Brook are no doubt those of the small brook. At Deacon's Cove, at the mouth of Rear Brook, according to Mr. Poole, a pit twenty-three feet deep struck six inches and a-half of oil coal, passing through light blue clay stone, full of fossil plants; and dark shales are found higher up this brook at the quarry.

Middle River.

About 100 yards above the bridge at Alma, Middle River displays red coarse conglomerate, dipping 155° < 50°, containing patches of grey soft sandstone and of red marl; some of the large pebbles are certainly derived from the millstone grit or coal measures, but most of them are Devonian. Down stream these rocks are succeeded by the Devonian, but again reappear and run up Brown's Brook, in which the conglomerate, in nearly horizontal bedding, includes red and greenish, calcareous, micaceous shale, sometimes coherent and like Lower Carboniferous. Among these beds is a six-inch layer of dark fine sandstone, full of carbonized plants of large size; overlaid by nut-and-egg conglomerate and grey, shaly sandstone, stained green with copper ore. At the mouth of McCulloch's Brook come coal measures, dipping steeply down stream, south of the north fault. Good outcrops of the conglomerate are seen along the Pictou Branch railway, immediately east of Middle River; it contains large pebbles of the reddish, greenish and grey sandstone of the millstone grit, but perhaps none of the coal measures; the dip is northward along the railway at a very low angle. North of the railway bridge, in the small brook shown by Mr. Hartley, as the northern limit of the conglomerate, no rocks are seen up to the bridge on the Nova Scotia Company's old railway, although large blocks of reddish sandstone are found, which may, however, be similar to the thick beds of red sandstone interstratified with the conglomerate in the railway cuttings at Middle River. But far to the northward on the shore are outcrops of conglomerate among layers of red soft marl and sandstone—alternations precisely similar to those on the west side of Middle River some distance back from the river, the western shore of which is skirted by red marl and sandstone, which appear to overlie the conglomerate and thus indicate a north-and-south fault, with a downthrow on the west side. North of the brickyard, conglomerate, sandstone and marl, with a low easterly dip, extend to Little Gut, on the north side of which a greenish and grey marly rock, exposed at the base of the cliffs, includes coaly streaks, overlaid by red marly shale and succeeded to the northward by a fine outcrop of reddish, nut-and-egg conglomerate, which, near the Granton wharves, dips steeply east.

North of this point the shore is low as far as Begg's Gut, where grey sandstone begins.

About 300 yards below the fork of McCulloch's Brook and Middle River, and half way between the river and the Truro road, in a little brook, are large blocks of fine sandstone and conglomerate. Lower down and about 450 yards above the dam, also on the right bank of the river, sandstone, marl and conglomerate are in contact with Devonian rocks, which apparently do not extend to the road. The conglomerate first seen in contact with the Devonian below the dam, and below Brown's Brook, dips steeply towards these rocks, from which it appears that the junction is a fault; in the brook it is not seen in direct contact with the Carboniferous rocks. The latter do not resemble the grey rocks of French's tunnel so much as strata somewhat lower in the series; they include, however, a band of dark grey underclay.

Devonian and Carboniferous ocks.

The road from Alma bridge westward to the cross-road appears to be all in conglomèrate, and in the other direction this rock extends apparently to the bridge on McCulloch's Brook, where the grey coal measures begin. The outcrops of New Glasgow conglomerate, first seen in McCulloch's Brook above the Truro road and in the neighbourhood of the high railway bridge, are succeeded by Devonian; but two patches lie nearly horizontally, higher up the bed of the brook, separated by Devonian strata. The hills and left bank of the river near the railway bridge seem to be an extension of those of the east side and to be composed of conglomerate. There is apparently, however, a fault down along the river hereabout.

McCulloch's Brook.

The little brook 365 yards south of Alma cross-roads shows no rocks above or below the road, but only blocks of grey sandstone. On the road south-east from Brown's carpenter shop, at the Truro road, good exposures of very crumbly nut-and-egg conglomerate are seen all the way to Brown's Brook. The watering brook above the Truro road shows only Devonian debris; but the Greenhill, along the south foot of which the road follows, shows coarse conglomerate everywhere on its steep sides, along the tops of the ridges and on its western terraced slopes. The soil of this hill is wonderfully good, having maintained its fertility for many years under constant cultivation. Near the foot of the hill is a very steep dip 167°, but in most parts the dip is nearly horizontal. Some of the blocks of greenish-grey sandstone in the conglomerate are two feet in diameter.

Greenhill.

Durham.

On the road from Durham up along Roddick Brook, are many blocks of reddish, soft sandstone. Above the crossing of the brook the latter shows outcrops of similar sandstone succeeded by conglomerate, with pebbles as large as cocoanuts, chiefly Pre-Carboniferous, but also of rusty fine sandstone, concretionary limestone and other Carboniferous rocks, which continue to the top of the hill, thence south to Salem Presbyterian church.

Sylvester.

The brooks north of Alma show good outcrops of the conglomerate, with a low dip, overlaid by reddish, softer rocks, containing scattered grains of bright red hematite. In Crockett Brook near the school, conglomerate dips at a very low angle. South of Sylvester station, in the brook between John Roy's and Elbridge Archibald's, reddish-grey, soft, flaggy sandstone, including patches of concretionary conglomeratic rock, dips northerly and easterly, probably at the apex of a basin. Further north the dip is more southerly.

West River fault.

The conglomerate of Greenhill is apparently interrupted near the West River by a fault; and higher rocks, still dipping eastward, occupy the country for some miles west of the river. It reappears, however, in Fitzpatrick Mountain, is exposed in Sawmill, Stewart and other brooks, and follows the high land to the westward. Towards Millsville, the sequence of these and the overlying formations can easily be made out in the brooks and rivers; and ledges of reddish coarse conglomerate on the roads show pebbles of reddish and green Upper Devonian flinty rocks and also of softer sandstone, probably Carboniferous.

Elmfield and Plainfield.

Igneous rock

Waugh River fault.

Elmfield Brook, above the post-road, shows red sandstone and marl, succeeded by conglomerate affected by a fault. In the upper branches of Plainfield Brook, grey, greenish-grey and reddish-grey sandstone and marl include bands of coarse, calcareous conglomerate, and the conglomerate which underlies these beds is then continuous to the head of the brook. In the left branch, below fine outcrops of conglomerate, are reddish sandstone and marl, with green layers, calcareous nodules and small veins, succeeded by a coarse conglomerate in contact with very flinty, igneous rocks. These and other fine outcrops of Mount Dalhousie require no special mention. With the conglomerate is always interstratified sandstone of great variety of texture and often marly; sometimes its pebbles are six inches in diameter; sometimes on approaching the older rocks it is too coarse and massive to show the dip. Numerous east-and-west faults affect these rocks, and their dip towards the mountain is no doubt due to one of these and perhaps also the disappearance of the conglomerate west of Waugh River; for it seems hardly probable that in so short

North of this point the shore is low as far as Begg's Gut, where grey sandstone begins.

About 300 yards below the fork of McCulloch's Brook and Middle River, and half way between the river and the Truro road, in a little brook, are large blocks of fine sandstone and conglomerate. Lower down and about 450 yards above the dam, also on the right bank of the river, sandstone, marl and conglomerate are in contact with Devonian rocks, which apparently do not extend to the road. The conglomerate first seen in contact with the Devonian below the dam, and below Brown's Brook, dips steeply towards these rocks, from which it appears that the junction is a fault; in the brook it is not seen in direct contact with the Carboniferous rocks. The latter do not resemble the grey rocks of French's tunnel so much as strata somewhat lower in the series; they include, however, a band of dark grey underclay.

Devonian and Carboniferous ocks.

The road from Alma bridge westward to the cross-road appears to be all in conglomerate, and in the other direction this rock extends apparently to the bridge on McCulloch's Brook, where the grey coal measures begin. The outcrops of New Glasgow conglomerate, first seen in McCulloch's Brook above the Truro road and in the neighbourhood of the high railway bridge, are succeeded by Devonian; but two patches lie nearly horizontally, higher up the bed of the brook, separated by Devonian strata. The hills and left bank of the river near the railway bridge seem to be an extension of those of the east side and to be composed of conglomerate. There is apparently, however, a fault down along the river hereabout.

McCulloch's Brook.

The little brook 365 yards south of Alma cross-roads shows no rocks above or below the road, but only blocks of grey sandstone. On the road south-east from Brown's carpenter shop, at the Truro road, good exposures of very crumbly nut-and-egg conglomerate are seen all the way to Brown's Brook. The watering brook above the Truro road shows only Devonian debris; but the Greenhill, along the south foot of which the road follows, shows coarse conglomerate everywhere on its steep sides, along the tops of the ridges and on its western terraced slopes. The soil of this hill is wonderfully good, having maintained its fertility for many years under constant cultivation. Near the foot of the hill is a very steep dip 167°, but in most parts the dip is nearly horizontal. Some of the blocks of greenish-grey sandstone in the conglomerate are two feet in diameter.

Greenhill.

Durham.

On the road from Durham up along Roddick Brook, are many blocks of reddish, soft sandstone. Above the crossing of the brook the latter shows outcrops of similar sandstone succeeded by conglomerate, with pebbles as large as cocoanuts, chiefly Pre-Carboniferous, but also of rusty fine sandstone, concretionary limestone and other Carboniferous rocks, which continue to the top of the hill, thence south to Salem Presbyterian church.

Sylvester.

The brooks north of Alma show good outcrops of the conglomerate, with a low dip, overlaid by reddish, softer rocks, containing scattered grains of bright red hematite. In Crockett Brook near the school, conglomerate dips at a very low angle. South of Sylvester station, in the brook between John Roy's and Elbridge Archibald's, reddish-grey, soft, flaggy sandstone, including patches of concretionary conglomeratic rock, dips northerly and easterly, probably at the apex of a basin. Further north the dip is more southerly.

West River fault.

The conglomerate of Greenhill is apparently interrupted near the West River by a fault; and higher rocks, still dipping eastward, occupy the country for some miles west of the river. It reappears, however, in Fitzpatrick Mountain, is exposed in Sawmill, Stewart and other brooks, and follows the high land to the westward. Towards Millsville, the sequence of these and the overlying formations can easily be made out in the brooks and rivers; and ledges of reddish coarse conglomerate on the roads show pebbles of reddish and green Upper Devonian flinty rocks and also of softer sandstone, probably Carboniferous.

Elmfield and Plainfield.

Igneous rock

Waugh River fault.

Elmfield Brook, above the post-road, shows red sandstone and marl, succeeded by conglomerate affected by a fault. In the upper branches of Plainfield Brook, grey, greenish-grey and reddish-grey sandstone and marl include bands of coarse, calcareous conglomerate, and the conglomerate which underlies these beds is then continuous to the head of the brook. In the left branch, below fine outcrops of conglomerate, are reddish sandstone and marl, with green layers, calcareous nodules and small veins, succeeded by a coarse conglomerate in contact with very flinty, igneous rocks. These and other fine outcrops of Mount Dalhousie require no special mention. With the conglomerate is always interstratified sandstone of great variety of texture and often marly; sometimes its pebbles are six inches in diameter; sometimes on approaching the older rocks it is too coarse and massive to show the dip. Numerous east-and-west faults affect these rocks, and their dip towards the mountain is no doubt due to one of these and perhaps also the disappearance of the conglomerate west of Waugh River; for it seems hardly probable that in so short a distance it should have lost its conglomerate character and have been replaced by finer sediments, as at Quarry Island.*

West Branch of River John.

The west branch of River John above the iron bridge at the village, flows between cliffs of coarse conglomerate, underlaid by red marl, succeeded up stream by dark grey fine grit, reddish, harsh, sandy shales and purplish and green mottled shales, with calcspar blotches mixed with albertite. At the mill-dam the rocks are vertical. Above the pond, coarse conglomerate and reddish crumbly marl, with green blotches, are overlaid by dark reddish-grey fine grit. These rocks are apparently not changed, either in dip or texture, by the trap with which they are in contact; they are followed up stream by marls with concretionary patches, sandstone spotted with baryte and films of albertite, which is in places the cementing material of the pebbles. Similar rocks extend to Loganville; then coarse conglomerate to the old rocks. The strata below the village are affected by one or more important faults which bring higher rocks in contact with a conglomerate, probably equivalent to that just described. Their relations to the beds lower down the river will be understood from the following approximate section which begins at Cape John and is measured in the river. The limestone (No. 15) is, perhaps, equivalent to that found above the conglomerate in the neighbourhood of New Glasgow. It is said to be hard to burn, but to yield a white, excellent lime greatly prized by plasterers and masons. Overlying it a seam of coal, several inches in thickness, is said to have been found among rocks resembling those of Quarry Island and Big Island and including beds of fine and coarse conglomerate.

Trap.

Albertite.

SECTION OF PERMIAN ROCKS IN RIVER JOHN IN DESCENDING ORDER.

| | Ft. | In. |
|---|---|---|
| 1. Grey and greenish-grey, crumbly, coarse sandstone, rusty-weathering, full of carbonized plants, underlaid by reddish sandstone and overlaid by grey fine sandstone, in shaly or thick beds, with spherical and cylindrical masses of fine rock sometimes 4 feet long ............ | 32 | 0 |

The thickness may be greater. For the next mile and a half the shore is occupied by red sandstone and marl with grey and greenish bands apparently underlying nearly to the lobster factory at Cape John†, where a coarse, grey sandstone, perhaps the same as above stands vertically in every direction, greatly broken to the "bill" of the Cape. The faults here are hard to understand.

Faults.

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*Geol. Surv. of Can., An. Rept., 1886, vol. II., p. 94 P.

†Trans. Geol. Soc., London, vol. IV., p. 507.

| | | Ft. | In. | |
|---|---|---|---|---|
| | From the "bill" eastward along the outer shore for three miles, the section is ascending to the bottom of a syncline, at a small brook which falls over the cliffs and in which occur small concretions of bog manganese. Perhaps the grey sandstone or conglomerate of the headland is the same as that already referred to, and is separated from all the rocks in the bottom of the basin by a fault. The syncline mentioned above may be only a turning of the strata towards a fault with upthrow on the north-west (magnetic) side which is followed by others near the "bill." | | | |
| 2. | Red sandstone and marl with greenish and grey layers and a band of concretionary rock. Some layers fit for quarrying. Dip turns to 232° $<$ 4°, and the thickness is consequently uncertain | 217 | 0 | |
| 3. | Grey somewhat impure limestone, quarried to a small extent | 2 | 0 | |
| 4. | Reddish wavy sandstone, with green blotches, interstratified with red argillaceous shale. Dip 325° $<$ 5° | 66 | 0 | |
| 5. | Measures concealed by the low shore north and south of Murphy's Creek. On the opposite shore are exposed several bands of grey and reddish, fine and coarse sandstone and shale, in one of which are the nodules of copper glance found on the shore at River John. Dip $<$ 5°. At the base of the long sand beach rocks are again well exposed | 545 | 0 | Copper ore. |
| 6. | Reddish soft sandstone and shale or marl, showing in places broad markings of *Cordaites*. Includes the bands upon which Hines's, Rogers's, and other quarries of the neighbourhood are situated, from which the celebrated brown stone of River John, used in the erection of the New Glasgow post office and other buildings, was obtained. Includes also the strata exposed in "The Brook," one of which contains many plants stained with copper. To the bridge at River John village. Dip 318° $<$ 8°. The exposures are by no means continuous, but wherever seen, the rocks dip at a low angle | 973 | 0 | Brown stone quarries. |
| 7. | Red, crumbly, micaceous sandstone and marl with concretionary, nodular, calcareous layers; grey, fine, banded sandstone, with a tinge of red, quarried in large blocks. To the south end of the railway bridge | 416 | 0 | |
| 8. | Reddish sandstone and shale, with layers of greenish, grey and reddish, nodular, concretionary, calcareous sandstone and grit, rusty in part, and holding plates of coal, perhaps albertite and carbonized plants. To the Telegraph road at Welsford | 164 | 0 | Coal. |
| 9. | Brick-red massive sandstone, seen in high cliffs at Man-of-War rock | 30 | 0 | Man-of-War rock. |
| 0. | Red sandstone and shale; grey flaggy and thick-bedded sandstone, some of fine grain but chiefly of coarse grit, of which one band, at least 25 feet thick, has been quarried; band of grey, calcareous, concretionary rock; several bands of coarse, green and red, spotted, concretionary rock, one of which passes into an impure limestone 18 inches thick. Like certain strata of Cape John shore, and not unlike the Trias of Truro | 970 | 0 | |

report, is said by McBean to be only two feet, and he supposes it to represent the ten inches of coal lying above the oil shale.

Potter's Brook fault.

From the Foord pit, levels have been extended a considerable distance east of the East River, and in the opposite direction round the end of a basin, across the supposed position of the Potter's Brook fault and to the high angle of the north rise. Instead of this fault there are here a great number of trifling north and south faults. On this north side of the basin, at Dan Tupper's on the Truro road, a coal seam has been worked, which is supposed by many to be the main seam but is perhaps rather a seam overlying that at some distance. The age of the rocks north of the Truro road at this point is a disputed question. They strongly resemble the Permian grey sandstone of the East River, north of the New Glasgow conglomerate; and their dip at Fraser's quarry is north at a very low angle.

North fault.

The north fault has been shown as crossing McCulloch's Brook a quarter of a mile north of its actual crossing, and, as already stated, the size of the Devonian area of this corner of the map is greatly exaggerated, the rocks in and south of Waters' Brook between Waters' quarry and the railway being millstone grit or Lower Carboniferous, and several large patches in McCulloch's Brook and Middle River, shown as Devonian, being New Glasgow conglomerate.

The rocks of the little branch of McLeod's Brook, between it and the Nova Scotia colliery, along which the road now follows, consist of grey, coarse, rusty-weathering sandstone, associated with one seam of dirty coal. Below the bridge are reddish-grey, fine, soft, marly sandstone and spotted concretionary, reddish-grey sandstone, probably the upper beds of the millstone grit, unless a fault intervenes, of which there seems to be no evidence.

## G. 4.—PERMIAN.

Subdivisions.

Rocks of this age as displayed between Merigomish and Pictou and along the north side of the Pictou coalfield, have been already described.* They may be subdivided as follows:—

1. New Glasgow conglomerate.
2. Middle grey sandstone and shale group, with small coal seams.
3. Upper red sandstone and shale group, with thin bands of limestone.

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*An. Rep. Geol. Surv., 1886, vol. II., Part P, p. 93.

Distribution.

These groups lie in parallel belts along the shore of Northumberland Strait between Merigomish and Wallace,* dipping seaward, generally at a low angle, but broken by faults sometimes of considerable magnitude. Between the second and third groups there is no distinct line of demarcation and the subdivision is only one of convenience.

### 1.—New Glasgow Conglomerate.

Although rocks of the lowest of these subdivisions occupy a belt from five to two miles wide between Fitzpatrick Mountain and Waugh River, they are entirely absent at Bailey's Bridge, one mile and a half west of Waugh River, owing either to a fault or to unconformity, the grey and brown sandstones coming upon the Pre-Carboniferous rocks of Tatamagouche Mountain. The other groups are everywhere present, exhibiting more or less persistence in their composition and appearance until traced into connection with the large areas in Cumberland county.

Evidence of age.

The outcrops of the conglomerate between Merigomish and the Middle River of Pictou, between Alma and Granton, have been fully described. At the Middle River, they are broken apparently by a great north-and-south fault, and on the west side of Greenhill by another, beyond which they reappear in Fitzpatrick Mountain and are continuous to Waugh River. Considering that the conglomerate at New Glasgow and elsewhere contains pebbles and blocks of grey sandstone which are as likely to have been derived from the coal measures as from the millstone grit (which here contains far more red beds than grey); that the millstone grit has not been proved unconformable to the coal measures, but seems rather to pass upwards into them, the presumption is strong that the New Glasgow conglomerate is newer than the coal measures, as assumed in last report, the absence of fragments of coal from such coarse conglomerates counting for nothing,† as a larger proportion of pebbles of syenite and diorite and of Devonian and Silurian slates is present in all the conglomerates. A hole 734 feet deep, bored on the south side of Sutherland Point, below New Glasgow, in search of coal, on the assumption that the coal measures were there concealed by an unconformable overlap of the Permian, seems rather to add weight to the supposition that the conglomerate is a basal portion of the Permian, a conclusion at which, I am informed by Mr. McBean, Sir William Logan arrived

New Glasgow Borehole.

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*Acadian Geol., p. 129.

†Trans. N. S. Inst. Sc., vol. VII., p. 202.

upon a re-examination of part of the coalfield subsequent to the publication of his report. The borehole seems to have cut only strata similar to those naturally exposed on Smelt Brook and on the river.

Fault.

At New Glasgow on the old Merigomish road, and south of it, about a-quarter of a mile from the bridge on the river, the conglomerate strikes 64°, vertically or with a steep dip to the south. Perhaps this is the fault mentioned by Mr. Poole.* The last outcrop is near the fork about 200 yards east of Church's livery stable. A steep dip is also seen on the left bank of East River, above the bridge. Perhaps both are due to the proximity of the north fault, which must be in that case subsequent to the deposition of the conglomerate, as are others in the neighbourhood of the Middle River.

Unconformity

Along Blackwood's millbrook, however, which, as described by Mr. Hartley, is the unconformable boundary between the conglomerate and millstone grit for some distance to the westward, the dip of the former is not so steep. The dip of the millstone grit in the first little tributary from the south, about 250 yards from the river road, is 29° < 62°, while the general dip of the conglomerate is much more northerly. Nearer the old quarry road, the millstone grit dips 44° < 66°, and still nearer, reddish harsh shales of the same age dip 51° < 66°. On the south side of the road at the bridge on this tributary, underclay and coal indicate the measures of the south side of the great north fault. The direct superposition of these rocks is seen in this brook at the dam forty yards above the bridge on the East River and twenty yards north of the old quarry road, showing very clearly the unconformity between the two groups. Grey sandstone, with greenish and reddish tints, dipping 42° < 51°, is overlaid by thick beds of very coarse conglomerate which fills depressions in the lower beds. These are not perhaps, however, necessarily higher than the Carboniferous limestone, patches of which are found on Waters's Hill, although included with the millstone grit by Mr. Hartley.

Coal and limestone

The limestone associated with the seam of coal which overlies the conglomerate at James Small's and William Fraser's (Moose) is said by Mr. Fraser to have been struck in a boring on Middle River, near Sylvester station, and to be there twenty feet thick. In Small's Brook the rocks of this horizon are well exposed, consisting of underclay, coaly shale and botryoidal limestone, but no pure coal seems to have been obtained. The dark layers are perhaps equivalent to those of the Smelt Brook described by Mr. H. Poole. According to Mr. Fraser, the coal and limestone come to the East

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*Trans. N.S. Inst. Sc., vol. I., p. 37.

River a little below the cemetery. To the westward they do not seem to have been satisfactorily traced, although the dark layers of Rear Brook are no doubt those of the small brook. At Deacon's Cove, at the mouth of Rear Brook, according to Mr. Poole, a pit twenty-three feet deep struck six inches and a-half of oil coal, passing through light blue clay stone, full of fossil plants; and dark shales are found higher up this brook at the quarry.

Middle River.

About 100 yards above the bridge at Alma, Middle River displays red coarse conglomerate, dipping 155° < 50°, containing patches of grey soft sandstone and of red marl; some of the large pebbles are certainly derived from the millstone grit or coal measures, but most of them are Devonian. Down stream these rocks are succeeded by the Devonian, but again reappear and run up Brown's Brook, in which the conglomerate, in nearly horizontal bedding, includes red and greenish, calcareous, micaceous shale, sometimes coherent and like Lower Carboniferous. Among these beds is a six-inch layer of dark fine sandstone, full of carbonized plants of large size; overlaid by nut-and-egg conglomerate and grey, shaly sandstone, stained green with copper ore. At the mouth of McCulloch's Brook come coal measures, dipping steeply down stream, south of the north fault. Good outcrops of the conglomerate are seen along the Pictou Branch railway, immediately east of Middle River; it contains large pebbles of the reddish, greenish and grey sandstone of the millstone grit, but perhaps none of the coal measures; the dip is northward along the railway at a very low angle. North of the railway bridge, in the small brook shown by Mr. Hartley, as the northern limit of the conglomerate, no rocks are seen up to the bridge on the Nova Scotia Company's old railway, although large blocks of reddish sandstone are found, which may, however, be similar to the thick beds of red sandstone interstratified with the conglomerate in the railway cuttings at Middle River. But far to the northward on the shore are outcrops of conglomerate among layers of red soft marl and sandstone—alternations precisely similar to those on the west side of Middle River some distance back from the river, the western shore of which is skirted by red marl and sandstone, which appear to overlie the conglomerate and thus indicate a north-and-south fault, with a downthrow on the west side. North of the brickyard, conglomerate, sandstone and marl, with a low easterly dip, extend to Little Gut, on the north side of which a greenish and grey marly rock, exposed at the base of the cliffs, includes coaly streaks, overlaid by red marly shale and succeeded to the northward by a fine outcrop of reddish, nut-and-egg conglomerate, which, near the Granton wharves, dips steeply east.

North of this point the shore is low as far as Begg's Gut, where grey sandstone begins.

Devonian and Carboniferous ocks.

About 300 yards below the fork of McCulloch's Brook and Middle River, and half way between the river and the Truro road, in a little brook, are large blocks of fine sandstone and conglomerate. Lower down and about 450 yards above the dam, also on the right bank of the river, sandstone, marl and conglomerate are in contact with Devonian rocks, which apparently do not extend to the road. The conglomerate first seen in contact with the Devonian below the dam, and below Brown's Brook, dips steeply towards these rocks, from which it appears that the junction is a fault; in the brook it is not seen in direct contact with the Carboniferous rocks. The latter do not resemble the grey rocks of French's tunnel so much as strata somewhat lower in the series; they include, however, a band of dark grey underclay.

McCulloch's Brook.

The road from Alma bridge westward to the cross-road appears to be all in conglomèrate, and in the other direction this rock extends apparently to the bridge on McCulloch's Brook, where the grey coal measures begin. The outcrops of New Glasgow conglomerate, first seen in McCulloch's Brook above the Truro road and in the neighbourhood of the high railway bridge, are succeeded by Devonian; but two patches lie nearly horizontally, higher up the bed of the brook, separated by Devonian strata. The hills and left bank of the river near the railway bridge seem to be an extension of those of the east side and to be composed of conglomerate. There is apparently, however, a fault down along the river hereabout.

Greenhill.

The little brook 365 yards south of Alma cross-roads shows no rocks above or below the road, but only blocks of grey sandstone. On the road south-east from Brown's carpenter shop, at the Truro road, good exposures of very crumbly nut-and-egg conglomerate are seen all the way to Brown's Brook. The watering brook above the Truro road shows only Devonian debris; but the Greenhill, along the south foot of which the road follows, shows coarse conglomerate everywhere on its steep sides, along the tops of the ridges and on its western terraced slopes. The soil of this hill is wonderfully good, having maintained its fertility for many years under constant cultivation. Near the foot of the hill is a very steep dip 167°, but in most parts the dip is nearly horizontal. Some of the blocks of greenish-grey sandstone in the conglomerate are two feet in diameter.

On the road from Durham up along Roddick Brook, are many blocks of reddish, soft sandstone. Above the crossing of the brook the latter shows outcrops of similar sandstone succeeded by conglomerate, with pebbles as large as cocoanuts, chiefly Pre-Carboniferous, but also of rusty fine sandstone, concretionary limestone and other Carboniferous rocks, which continue to the top of the hill, thence south to Salem Presbyterian church.

Durham.

The brooks north of Alma show good outcrops of the conglomerate, with a low dip, overlaid by reddish, softer rocks, containing scattered grains of bright red hematite. In Crockett Brook near the school, conglomerate dips at a very low angle. South of Sylvester station, in the brook between John Roy's and Elbridge Archibald's, reddish-grey, soft, flaggy sandstone, including patches of concretionary conglomeratic rock, dips northerly and easterly, probably at the apex of a basin. Further north the dip is more southerly.

Sylvester.

The conglomerate of Greenhill is apparently interrupted near the West River by a fault; and higher rocks, still dipping eastward, occupy the country for some miles west of the river. It reappears, however, in Fitzpatrick Mountain, is exposed in Sawmill, Stewart and other brooks, and follows the high land to the westward. Towards Millsville, the sequence of these and the overlying formations can easily be made out in the brooks and rivers; and ledges of reddish coarse conglomerate on the roads show pebbles of reddish and green Upper Devonian flinty rocks and also of softer sandstone, probably Carboniferous.

West River fault.

Elmfield Brook, above the post-road, shows red sandstone and marl, succeeded by conglomerate affected by a fault. In the upper branches of Plainfield Brook, grey, greenish-grey and reddish-grey sandstone and marl include bands of coarse, calcareous conglomerate, and the conglomerate which underlies these beds is then continuous to the head of the brook. In the left branch, below fine outcrops of conglomerate, are reddish sandstone and marl, with green layers, calcareous nodules and small veins, succeeded by a coarse conglomerate in contact with very flinty, igneous rocks. These and other fine outcrops of Mount Dalhousie require no special mention. With the conglomerate is always interstratified sandstone of great variety of texture and often marly; sometimes its pebbles are six inches in diameter; sometimes on approaching the older rocks it is too coarse and massive to show the dip. Numerous east-and-west faults affect these rocks, and their dip towards the mountain is no doubt due to one of these and perhaps also the disappearance of the conglomerate west of Waugh River; for it seems hardly probable that in so short

Elmfield and Plainfield.

Igneous rock

Waugh River fault.

a distance it should have lost its conglomerate character and have been replaced by finer sediments, as at Quarry Island.*

**West Branch of River John.**

**Trap.**

**Albertite.**

The west branch of River John above the iron bridge at the village, flows between cliffs of coarse conglomerate, underlaid by red marl, succeeded up stream by dark grey fine grit, reddish, harsh, sandy shales and purplish and green mottled shales, with calcspar blotches mixed with albertite. At the mill-dam the rocks are vertical. Above the pond, coarse conglomerate and reddish crumbly marl, with green blotches, are overlaid by dark reddish-grey fine grit. These rocks are apparently not changed, either in dip or texture, by the trap with which they are in contact; they are followed up stream by marls with concretionary patches, sandstone spotted with baryte and films of albertite, which is in places the cementing material of the pebbles. Similar rocks extend to Loganville; then coarse conglomerate to the old rocks. The strata below the village are affected by one or more important faults which bring higher rocks in contact with a conglomerate, probably equivalent to that just described. Their relations to the beds lower down the river will be understood from the following approximate section which begins at Cape John and is measured in the river. The limestone (No. 15) is, perhaps, equivalent to that found above the conglomerate in the neighbourhood of New Glasgow. It is said to be hard to burn, but to yield a white, excellent lime greatly prized by plasterers and masons. Overlying it a seam of coal, several inches in thickness, is said to have been found among rocks resembling those of Quarry Island and Big Island and including beds of fine and coarse conglomerate.

### SECTION OF PERMIAN ROCKS IN RIVER JOHN IN DESCENDING ORDER.

| | Ft. | In. |
|---|---|---|
| 1. Grey and greenish-grey, crumbly, coarse sandstone, rusty-weathering, full of carbonized plants, underlaid by reddish sandstone and overlaid by grey fine sandstone, in shaly or thick beds, with spherical and cylindrical masses of fine rock sometimes 4 feet long .... | 32 | 0 |

**Faults.**

The thickness may be greater. For the next mile and a half the shore is occupied by red sandstone and marl with grey and greenish bands apparently underlying nearly to the lobster factory at Cape John†, where a coarse, grey sandstone, perhaps the same as above stands vertically in every direction, greatly broken to the "bill" of the Cape. The faults here are hard to understand.

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*Geol. Surv. of Can., An. Rept., 1886, vol. II., p. 94 P.

†Trans. Geol. Soc., London, vol. IV., p. 507.

| | Ft. | In. | |
|---|---|---|---|
| From the "bill" eastward along the outer shore for three miles, the section is ascending to the bottom of a syncline, at a small brook which falls over the cliffs and in which occur small concretions of bog manganese. Perhaps the grey sandstone or conglomerate of the headland is the same as that already referred to, and is separated from all the rocks in the bottom of the basin by a fault. The syncline mentioned above may be only a turning of the strata towards a fault with upthrow on the north-west (magnetic) side which is followed by others near the "bill." | | | |
| 2. Red sandstone and marl with greenish and grey layers and a band of concretionary rock. Some layers fit for quarrying. Dip turns to 232° < 4°, and the thickness is consequently uncertain | 217 | 0 | |
| 3. Grey somewhat impure limestone, quarried to a small extent | 2 | 0 | |
| 4. Reddish wavy sandstone, with green blotches, interstratified with red argillaceous shale. Dip 325° < 5° | 66 | 0 | |
| 5. Measures concealed by the low shore north and south of Murphy's Creek. On the opposite shore are exposed several bands of grey and reddish, fine and coarse sandstone and shale, in one of which are the nodules of copper glance found on the shore at River John. Dip < 5°. At the base of the long sand beach rocks are again well exposed | 545 | 0 | Copper ore. |
| 6. Reddish soft sandstone and shale or marl, showing in places broad markings of *Cordaites*. Includes the bands upon which Hines's, Rogers's, and other quarries of the neighbourhood are situated, from which the celebrated brown stone of River John, used in the erection of the New Glasgow post office and other buildings, was obtained. Includes also the strata exposed in "The Brook," one of which contains many plants stained with copper. To the bridge at River John village. Dip 318° < 8°. The exposures are by no means continuous, but wherever seen, the rocks dip at a low angle | 973 | 0 | Brown stone quarries. |
| 7. Red, crumbly, micaceous sandstone and marl with concretionary, nodular, calcareous layers; grey, fine, banded sandstone, with a tinge of red, quarried in large blocks. To the south end of the railway bridge | 416 | 0 | |
| 8. Reddish sandstone and shale, with layers of greenish, grey and reddish, nodular, concretionary, calcareous sandstone and grit, rusty in part, and holding plates of coal, perhaps albertite and carbonized plants. To the Telegraph road at Welsford | 164 | 0 | Coal. |
| 9. Brick-red massive sandstone, seen in high cliffs at Man-of-War rock | 30 | 0 | Man-of-War rock. |
| 0. Red sandstone and shale; grey flaggy and thick-bedded sandstone, some of fine grain but chiefly of coarse grit, of which one band, at least 25 feet thick, has been quarried; band of grey, calcareous, concretionary rock; several bands of coarse, green and red, spotted, concretionary rock, one of which passes into an impure limestone 18 inches thick. Like certain strata of Cape John shore, and not unlike the Trias of Truro | 970 | 0 | |

| | | | Ft. | In. |
|---|---|---|---|---|
| | 11. | Red sandstone and marl; fine, thick-bedded, grey, wavy sandstone with concretionary patches and layers of grey coarse grit. Exposed as far as Weir's mill. Dip 337° < 12°. These enormous thicknesses may possibly be due to original deposition on a slope, or the steeper dips may indicate faults which cross in the concealed spaces | 1,053 | 0 |
| Grindstones.<br>Copper ore. | 12. | Grey, coarse, pebbly sandstone, overlaid by reddish sandstone and shale, and by grey, fine, flaggy sandstone which has been quarried and includes bands of red sandstone and shale, and of calcareous, flaggy, concretionary limestone-conglomerate. These latter often occur among the grey sandstones. Grey and greenish fine sandstone then extend for a great distance. The grey sandstone largely predominates, and many beds have been quarried for grindstones. Well exposed to the mouth of the little brook south of the McNab road. Dip < 25°. This high angle of dip prevails for nearly the whole distance, and does not seem due to false bedding or faulting. Copper ore has been found at this brook | 3,124 | 0 |
| | 13. | Reddish conglomerate and coarse grit < 9° | 340 | 0 |
| | 14. | Red and grey, mottled, concretionary, fine and coarse sandstone. | 10 | 0 |
| Limestone. | 15. | Grey botryoidal limestone quarried below William Matheson's, on the left bank of the river, and also on the right bank. It is wrinkled, compact, somewhat impure, mixed with clay and sand | 5 | 0 |
| Fault. | 16. | Reddish sandstone and shale, reddish crumbly conglomerate and whitish fine sandstone. The conglomerate greatly predominates; it is generally pea-and-nut conglomerate, but holds pebbles 18 inches in diameter. Among others of syenite, felsite, &c., are pebbles of reddish, soft, Carboniferous sandstone and grit. Dip 0° < 10°. To a fault about 1,000 feet below the fork of the east branch. From the fault the continuity of the section is perhaps unbroken to the mouth of the river | 160 | 0 |
| | 17. | Brownish-grey, fine, sandy flags; reddish-grey sandstone with layers of reddish argillaceous rock, spotted with green; crumbly shale with whitish and greenish patches; concretionary beds full of nodules of impure limestone as large as eggs; patches of whitish-green grit. Some of the rocks show rain marks and blotches of calcspar. These rocks occupy a space of about 1 mile along the bends of the river, and are perhaps unconformably below the foregoing. They are broken by two faults, and a third occurs at their base | .. | .. |
| Albertite. | 18. | Greenish-grey, reddish and brownish argillaceous shale and somewhat soft sandstone in irregular flags, more or less calcareous and concretionary, with films of calcite and albertite in the joints. The red strata predominate, the grey sandstone is of good grindstone grit. Exposed only at intervals, dipping 341° < 32°, to an east-and-west fault, at the base of 17, which crosses the west branch about 1 mile below the bridge | .. | .. |
| | 19. | Measures concealed | .. | .. |

| | Ft. | In. |
|---|---|---|
| 20. Dark grey coherent conglomerate with a few veins of calcspar, overlaid by reddish fine sandstone. Dip 292° < 10°. Seen below the bridge at West Branch, but exposed for only a short distance. Perhaps the same as 16 | .. | .. |
| Total thickness of Permian rocks | 8,107 | 0 |

North Earltown.

Waugh River.

Coal.

The conglomerate of North Earltown overlies Silurian, igneous and, probably, Devonian rocks; that of the Biorachin rests upon Silurian, whereas that of Mount Dalhousie is in contact with felsitic rocks: it is composed chiefly of Devonian debris. Many blocks of grey sandstone occur on the Earltown road near the county line, but in the brooks to the southward there are outcrops of conglomerate, like that of Loganville, which extends north apparently to the fork of the Denmark road, and is abundant about McBean's Corner. Outcrops are seen almost everywhere within the limits marked on the map, which are generally well defined; and it would be useless to attempt to enumerate all the localities. In Matheson Brook, not far above its confluence with Waugh River, is a cliff of grey rusty-weathering sandstone, underlaid by grey concretionary limestone-conglomerate, with plates of baryte in the joints, near which a little coal is said to have been found. Further up stream the brook comes through a small spring, bog or barren, on which nothing grows, and from which have been taken pieces of wood impregnated with copper ore; above which reddish-grey fine sandstone, in thick beds, is underlaid by reddish conglomerate, with which the brook is floored all the way up to and beyond the mouth of Moore's Brook. Boulders of Silurian rock found in this conglomerate exceed three feet in length, and perhaps give rise to the large number of field-stones, full of Silurian fossils, which overspread the country between Balmoral mills and the falls of Waugh River. The conglomerate of Waugh River occurs at the base of a succession of Permian rocks between Tatamagouche Harbour and the mountains, of which the following is the approximate thickness and section. French River section begins from the same point but is four miles and a half distant at the base.

### SECTION OF PERMIAN ROCKS IN WAUGH RIVER FROM WHARF AT TATAMAGOUCHE VILLAGE IN DESCENDING ORDER.

| | Ft. | In. |
|---|---|---|
| 1. Red marl and sandstone, including a bed which has been quarried. To bridge on the Telegraph road. Dip 44° < 8° | 64 | 0 |
| 2. Reddish-grey, coarse, pebbly sandstone, underlaid by red marl and sandstone. To bridge on the back road | 173 | 0 |

| | | Ft. | In. |
|---|---|---|---|
| | 3. Red marl and sandstone, with a band of dark shale towards the bottom | 375 | 0 |
| Quarries. | 4. Reddish-grey, coarse, pebbly, massive sandstone, with partings of red and green shale. Quarried | 20 | 0 |
| | 5. Red marl and sandstone. Dip 1° < 13°. To mouth of the Black Brook | 282 | 0 |
| | 6. Red marl with bands of shaly and flaggy sandstone and including layers of greenish-grey sandstone and of coarse limestone-conglomerate. The latter passes into a grit full of calcspar veins and nodules of reddish impure limestone. The sandstone is sometimes fit for quarrying. In one of the lowest concretionary beds near the bridge copper has been mined. To the red bridge at the mills of Waugh River post office | 682 | |
| | 7. Rocks for the most part concealed or where seen consisting of reddish and grey soft sandstone and shale. To the mouth of Yellow Brook | 653 | 0 |
| | 8. Grey and greenish-grey coarse and fine sandstone, in rough, flaggy beds, with lenticular layers of greenish-grey concretionary limestone-conglomerate. Some beds of light-grey colour and good grindstone grit, in smooth, even layers of 2 feet and 1 foot in thickness, have been quarried. Underlaid by reddish-grey, somewhat coarse, pebbly, soft, micaceous sandstone, often striped and spotted with black, and by brown or indian-red fine sandstone, with green spots, false-bedded. In the quarry-sandstone are occasional hard spots and soft patches. Some beds are prettily striped greenish-grey and brown. Well seen in the Yellow Brook. Markings of plants. Red, soft, marly layers. To near the mouth of Four Mile Brook. Dip 346° < 13° | 490 | ( |
| Copper ore.<br>Albertite. | 9. Between the mouths of Four Mile and Matheson Brooks. Rocks also well seen in Four Mile and Sutherland Streams and in Yellow Brook near Frederick Haymond's. Brownish and grey sandstone and banded and spotted, arenaceous shale, with layers of dark reddish-grey sandstone. Also greenish-grey, fine and coarse, flaggy sandstone, full of broken plants, with concretionary, coarser patches, containing traces of copper ore dug in the Yellow Brook about half a mile below John McKay's ; fucoids in grey and reddish soft shales. Some beds of fine sandstone which have been quarried. Brownish, and grey and blackish, fine, micaceous flags, like rocks in the east branch of River John, not far above the fork of the west branch. The brown stone is sometimes in bands 20 feet thick and somewhat massive or in even flags, some of it fine in colour and texture. Layers of limestone-conglomerate. Blotches and bands of hematite, seen in Four Mile Brook. "Bulls" of harder sandstone ; comminuted plants. A streak of albertite, a quarter of an inch thick in bedding of grey, fine sandstone. Films of baryte in the joints. A very large preponderance of sandstone usually more or less grey. Dip 346° < 11° | 580 | |

| | Ft. | In. |
|---|---|---|
| 10. Sandstone similar to No. 9, to the boundary of the conglomerate. A thickness of about half of this or 195 feet brings us to the base to the felsitic rocks at East New Annan; and at Bailey's bridge this is the base there being no conglomerate. The dip at both these localities is low, so that perhaps there is an overlapping and not a fault, in which case the grey sandstone would appear to be unconformable to the conglomerate.................... | 390 | 0 |
| 11. Conglomerate, seen well in a picturesque, rocky valley above and below the falls. Reddish-grey, nut-and-egg; pebbles chiefly of fossiliferous Silurian rock and of reddish flinty sandstone, like that of Earltown supposed to be Devonian. Some boulders several feet in diameter. Reddish-grey, soft sandstone layers. Lines of bedding sometimes dip at a very high angle but obscure. Thickness consequently doubtful: it occupies a breadth of about 5940 feet, < 13°.................................... | 1,336 | 0 |
| 12. *Pre-Carboniferous.* Light grey and greenish-grey, fragmental, flinty agglomerate or breccia of dioritic or felsitic aspect; contains much chlorite, a few blotches of quartz and syenite. Has occasionally a minute jointing or lamination................. | .... | . |
| Total thickness................................ | 5,045 | 0 |

Florida road.

In the Millbrook, a tributary of French River, at 500 and again at 800 yards above the Florida road, and also in the fields east of that brook, a conglomerate is in place which resembles that of New Glasgow; it has been included by Dr. Ells with the Lower Carboniferous. About 800 yards below the road, reddish-grey and brownish, soft shale and flaggy sandstone dip 9° < 35° and extend for some distance down stream, including bands of good grindstone grit, and, about one mile and a half below the road, traces of coal. Grey sandstone occurs along the Florida road to the westward, and has been quarried in Higgins Brook; it has the tinge of pink characteristic of the rocks which overlie the conglomerate to the eastward, and is hardly distinguishable from the rocks of Wallace River, at the bridge on the road to Westchester station, coloured Permian on Dr. Ells's map. The road to Swallow settlement shows indications of sandstone, like that of French River, and of a coarse, reddish conglomerate.

The road to Westchester station from the bridge mentioned above, runs south along the west side of Wallace River for about a mile, then turns to the westward; it shows no definite exposures as far as the road which turns to the right across the west branch of Wallace River. About a quarter of a mile north on this latter road, however, are probable outcrops of reddish-grey, crumbly, fine sandstone, and at the bridge over the west branch are cliffs and reefs of fine, reddish, Permian sandstone, in thick beds. Up stream the river exposes reddish, brownish, grey, and greenish, thick-bedded sandstone, fine smooth flags and marly shales, dipping north-easterly at a low angle, with coarse, calcareous, concretionary layers; underlaid by reddish soft, nut-and-egg conglomerate, dipping 350° < 10°, and interstratified with greenish-grey fine and coarse sandstone, coarse quartzose flags and dark reddish and grey sandstone and argillite, among which was seen an upright *Sigillaria*, two feet in diameter. The conglomerate is very like the Lower Carboniferous conglomerate of McElman Brook and the railway west of Londonderry. Up the branch from Westchester station are rough beds of reddish-grey somewhat crumbly, nut-and-egg conglomerate, with layers of dark reddish sandstone, precisely like the rocks of the west branch of River John below Loganville. The proportion of finer sandy beds is very small; some of the pebbles are more than a foot in diameter, and fine exposures occur in cliffs both above and below Greenville station and as far as the bridge on the railway, above which, at Purdy's mill near Westchester station, grey sandstone is said to have yielded threads of coal.

Greenville

In the other branch of the river, west of Greenville station, outcrops of reddish, coarse conglomerate, grit and sandstone are also found above the railway, along which westward towards Thomson station, and also on the road from the station south to Williamsdale, and on River Philip above the railway, similar rocks dip northerly at a low angle. But as already remarked, the Permian resembles the Lower Carboniferous and millstone grit in lithological character and there are evidently faults along the north side of the Cobequid Hills as well as on the south; so that it would be rash to attach too much importance to these indications without a closer investigation of this district.

### 2.--Permian Middle Group.

In the two sections presented above, the grey, brownish and reddish sandstones which overlie the conglomerate have been described; and many particulars concerning those which occur on the Big Island of Merigomish and on the coast between King Head and Pictou Harbour were given in last report.* The coal of the Big Island of Merigomish is said to be again found near the lighthouse on King Head, from which coal is said to have been taken a few years ago. Coal is also said by Sir J. W. Dawson to occur at Little Harbour, at Abercrombie and at the mouth of Middle River;† by Mr. Poole,

Coal.

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*Geol. Surv. of Can., An. Rept., 1886, vol. II., p. 95 P.

†Acadian Geol., pp. 326 and 343.

to be found between Abercrombie Point and New Glasgow, and again near the gas-works at Pictou. Several quarries have been opened on the grey sandstone north of New Glasgow, the dip being at a low angle, somewhat hard to distinguish precisely, even with large exposures. Quarries.

A section of the strata between Smelt Brook and Shipyard Point is given by Mr. Poole,* together with many particulars about the rocks of the west side of the East River. Smelt Brook.

Rear Brook above the bridge on the shore-road exposes grey and greenish-grey, nearly horizontal sandstone, full of carbonized plants, interstratified with greenish, rusty, grey and red argillaceous shales and a thin band of underclay. Below Captain Fraser's quarry, a spring deposits yellow ochre; at the quarry is a little band of coaly shale less than a foot in thickness, containing *Cordaites*, fish-scales, teeth and coprolites; above it are grey and greenish flags with a bed of black calcareo-bituminous shale showing markings of plants. On the road towards New Glasgow the point of junction of the conglomerate and grey sandstone is not seen, although many pieces of the latter are found near the first brook south of Rear Brook, and up stream to a farm road, above which are fragments of reddish sandstone, perhaps millstone grit. Rear Brook.

At Abercrombie Point, from the ferry wharf south towards the loading ground, broken, grey sandstone is in the road-cuttings; and further south coaly debris, 120 paces north of a little brook at which is a fine spring, said to come from a bore-hole. Another boring was made at the mouth of this brook, and search for coal lately renewed by Mr. Hugh Fraser and others. At 405 paces further south is a little brook upon which is a spring and bore-hole, on Matheson's farm, mentioned by Mr. Poole.† Abercrombie.

East of McKeen's quarry at Pictou a piece of very rough land shows blocks of coarse sandstone, like that of the shore west of Widow Point. At Mr. Smith's (ice dealer), north of the town-line and west of the road to the Millbrook, the dip is said to be due east at a moderate angle. At Brown's Point is an exposure of red soft shale. Thence along the railway towards Scotch Hill, the debris of similar rocks abounds, the country being low and the streams showing no outcrops. About a quarter of a mile east of Scotch Hill station are blocks of grey fine sandstone, a hill lying on the right. In Lyons Brook, immediately below the dam, are alterna- Pictou.

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*Trans. N. S. Inst. Sc., vol. I., pp. 36 and 39; Acadian Geol., Supplement, 1878, p. 35.

†Trans. N. S. Inst. Sc., vol. I., p. 36.

tions of grey and reddish sandstone and shale, with a very high southerly dip down to a bridge on a farm road below which the dip is low. At the railway on a branch of Lyons Brook, the dip is 167° < 35° and immediately to the westward is a nearly vertical northerly dip which probably indicates that the fault is just at the railway track, passes through the Big Marsh and meets a fault shown by the dip in Black River. At the crossing at the main road to the westward, a steep hill is on the right, composed apparently of grey sandstone, resembling that of Battery Point and the marine slip. The high easterly dip north of the southerly dip of Haliburton Creek may point to a master fault coming from the south, which continues to the northward, but against which the Lyons Brook fault ends.

Pictou Harbour.

From Pictou to Brown's Point the railway closely follows the shore which shows no rocks but only a loose, coarse sand formed from grey sandstone like that found near the marine slip at Pictou, near Pictou Landing and the lighthouse. On the shore towards Haliburton Creek are indefinite outcrops of brownish, crumbly sandstone, with a very low easterly dip; and beyond two little brooks where the road comes close to the shore near Gavin Island, is a small outcrop of coarse conglomerate, interstratified with grey, shaly sandstone. No rocks are then seen as far as Sawmill Brook, above the bridge over which, however, grey sandstone has been largely quarried. Further up the harbour is a small exposure of red sandstone and marl; but all the shore is low in the neighbourhood of the bridge over West River, and also down the right bank towards Loch Broom Point for a great distance. At and near the point, conglomerate and reddish concretionary sandstone are interstratified with harder, globular, concretionary masses, almost horizontal. From Loch Broom Point up the Middle River the shore is fringed with marshes infested with mosquitoes, and the cuttings on the railway are in clay and gravel as far as the bridge, above which reddish, coarse, bouldery conglomerate is met with.

Loch Broom.

North of the marine slip at Pictou, the rocks exposed are for the most part grey crumbly sandstone, lying at a low angle, the dip at the south end of the hospital grounds being 87° < 12.°

Mr. Fraser s section of bore-holes at Pictou.

In the town of Pictou several deep borings have been made in search of water; and from the records of these a section of the Permian strata between the most easterly at the marine slip and the conglomerate of Haliburton Creek, has been made by Mr. R. P. Fraser. The dip is assumed to be easterly < 1 in 7·5. Good sections of two of these bore-holes at Campbell's tannery and Fraser's, give the greater part of the thickness. The principal bore-holes are :—

1. Campbell's tannery, bore-hole 677 feet deep, 60 feet above tide, gives strata to Haliburton Creek, 5,000 feet.
2. McKimmie's, 300 feet deep, 80 feet above tide, 863 feet east of or to deep of No. 1 (=115 feet vertical and 20 feet higher) gives 135 feet of strata overlying No. 1.
3. Howard Primrose's, 140 feet deep, 30 feet above tide, 425 feet to deep of No. 2, all grey freestone. Only 7 feet above top of No. 2.
4. Fraser's, 380 feet deep, 130 feet above tide, 1,100 feet to deep of No. 3, gives 247 higher than 3. Cores at the Pictou Academy.
5. Clarence Primrose's house, 288 feet deep, 70 feet above tide, 1,300 feet to deep of No. 4, gives 113 feet higher than it.
6. Clarence Primrose's mills, 600 feet deep, 20 feet above tide, a little to the rise of No. 5. Cuts the same strata.
7. McConnell's, 121 feet deep, 20 feet above tide, 838 feet east of No. 5, gives 112 feet above No. 5.
8. Ross's borehole, 147 feet deep, 30 feet above tide, 635 feet east of No. 5, gives 43 feet above No. 5.

The section is as follows :—

SECTION OF PERMIAN ROCKS AT PICTOU.

| | | Ft. | In. |
|---|---|---|---|
| 1. | Red clay | 15 | 0 |
| 2. | Dark, mixed, hard rock | 5 | 0 |
| 3. | Red soft clay | 15 | 0 |
| 4. | Red sandstone | 20 | 0 |
| 5. | Dark sandstone mixed with gravel (water) | 11 | 0 |
| 6. | Grey, soft, pebbly freestone | 10 | 0 |
| 7. | White hard freestone | 3 | 0 |
| 8. | Bluish hard freestone | 32 | 0 |
| 9. | Fire clay (1 to 9 in McConnell's borehole) | 10 | 0 |
| 10. | Measures concealed | 25 | 0 |
| 11. | Grey and bluish freestone | 32 | 0 |
| 12. | Soft, bluish clay-stone | 13 | 0 |
| 13. | Grey freestone | 30 | 0 |
| 14. | Red clay-shale | 1 | 6 |
| 15. | Bluish freestone | 25 | 0 |
| 16. | Red clay (9 to 16 from bore-hole at Clarence Primrose's house) | 18 | 0 |
| 17. | Red shale (17 to 34 cut in Fraser's) | 8 | 0 |
| 18. | Light shale | 6 | 0 |
| 19. | Light freestone | 22 | 0 |
| 20. | White coarse sandstone | 29 | 0 |
| 21. | Red shale | 1 | 0 |
| 22. | Grey sandstone | 38 | 4 |
| 23. | Red shale | 20 | 0 |
| 24. | Light shale | 7 | 0 |
| 25. | Red shale | 23 | 3 |
| 26. | Red sandstone | 20 | 9 |
| 27. | Light shale | 1 | 3 |
| 28. | Grey sandstone | 22 | 9 |

| | | Ft. | In. |
|---|---|---|---|
| 29. | Sandstone, fine, grey ; 8 feet coarse and 6 feet brown | 51 | 0 |
| 30. | Red shale with partings of red sandstone--great run of water | 13 | 0 |
| 31. | Grey sandstone, cut in McKimmie's boring 28 feet from surface and in Howard Primrose's, 54 from surface | 24 | 0 |
| 32. | Red shale | 9 | 6 |
| 33. | Red shale with bands of red sandstone ; calcareous | 44 | 6 |
| 34. | Grey freestone—cut in Campbell's tannery bore-hole and perhaps No. 31 repeated | 58 | 0 |
| 35. | Red clay rock | 3 | 0 |
| 36. | Red clay rock with light partings | 19 | 0 |
| 37. | Red clay rock | 73 | 0 |
| 38. | Red rocks of lighter colour | 10 | 0 |
| 39. | Grey freestone | 18 | 0 |
| 40. | Fine grey sandstone with coal partings | 3 | 0 |
| 41. | Limestone, oolitic or concretionary | 1 | 0 |
| 42. | Bluish fire clay | 2 | 0 |
| 43. | Red marl | 27 | 0 |
| 44. | Red marl with sandstone partings | 29 | 0 |
| 45. | Red marl | 36 | 0 |
| 46. | Grey sandstone | 1 | 0 |
| 47. | Light marl | 5 | 0 |
| 48. | Red marl | 43 | 0 |
| 49. | Red marl mottled | 25 | 0 |
| 50. | Red marl | 30 | 0 |
| 51. | Red sandstone | 1 | 0 |
| 52. | Red marl | 21 | 0 |
| 53. | Red marl and sandstone | 13 | 0 |
| 54. | Red sandstone | 16 | 0 |
| 55. | Sandstone-conglomerate | 2 | 0 |
| 56. | Red marl | 11 | 0 |
| 57. | Red sandstone | 79 | 0 |
| 58. | Sandstone-conglomerate | 1 | 0 |
| 59. | Red sandstone | 21 | 0 |
| 60. | Red sandstone with beds of marl | 10 | 0 |
| 61. | Red sandstone | 17 | 0 |
| 62. | Red sandstone with beds of marl | 15 | 0 |
| 63. | Red sandstone | 23 | 0 |
| 64. | Red marl | 21 | 0 |
| 65. | A millstone-conglomerate to be seen at Haliburton Creek, where the brook enters the pond above the cemetery | 41 | 0 |
| 66. | Grey sandstone | 0 | 8 |
| 67. | Red sandstone | 0 | 4 |
| 68. | Red marl, bottom of Campbell's tannery bore-hole | 10 | 0 |
| | Total thickness | 1,146 | 10 |

**Haliburton Creek.**

On the railway between Brown's Point and Haliburton Creek, cuttings have exposed greenish shale, flaggy sandstone, and red marl and sandstone. Above the railway, on the west side of the

Fault.

creek, similar rocks include a layer of nut conglomerate, and near a tributary dip 147° < 55° a reddish mottled sandstone containing impressions of fucoids. Near the head of this tributary, immediately below a bridge on the road, the dip 177° < 65° probably indicates a fault, the general dip being easterly. In the brook above the road, red rocks contain plants in greenish and grey layers and concretionary, calcareous beds. Above the cemetery bands of coarse sandstone and conglomerate are interstratified with marls, concretionary limestone and patches of rusty-weathering sandstone, spotted with coaly matter.

Scotsburn.

Copper ore.

Along the Pictou and Oxford railway, from Brown's Point to Scotch Hill station, no other rocks are seen; but the ditch-cuttings seem to indicate red shales and sandstones overlying the grey sandstones of Sawmill Brook. Lyons Brook shows good exposures of the red strata, and at the railway is a nearly vertical dip which seems to indicate an extension of the fault referred to above. Hardwood Hill is composed chiefly of grey sandstone. Before reaching Scotsburn the hill of conglomerate is close on the left, and the rocks immediately overlying the conglomerate are probably those which contain the copper ore of Scotsburn Brook. These comprise greenish-grey fine sandstone and shale, marked with plants impregnated with coaly matter and copper ores, together with reddish and greenish shales and marls dipping 127° < 33°. Large banks of gravel reach nearly up to the mine, and a plain extends to the road behind McIntosh's. Up stream no rocks are met with for some distance, but on the steep hill to the southward conglomerate is apparently in place, separated, perhaps, from the grey and reddish sandstones in the brook at the foot of the escarpment by a fault. In the little brook north of Scotsburn station, immediately above the main road, greenish-grey shaly sandstone, like that of the copper mine, dips 89° < 24° in smooth beds, associated with layers of coarser texture; and a little higher is underlaid with coarse Permian conglomerate.

Saltsprings.

In the West River, above Saltsprings, the soft rocks which come against the Devonian are probably of this age, for they resemble more closely the Permian of Big Island than Carboniferous rocks. Those first seen on the left bank are indian-red, soft, micaceous shales and sandstones. At the wire footbridge, light greenish-grey, fine, crumbly, calcareous sandstone and conglomerate, dipping 133° < 70°, are followed by concretionary red rocks and by grey fine sandstone, crowded with broken carbonized plants, passing into streaks of coal, including patches of conglomerate and balls of

Eight Mile Brook.

harder sandstone. Near the confluence of the Eight Mile Brook a grey, fine, red-spotted sandstone, jointed and broken, also abounds in carbonized plants, and contains patches of reddish soft marl and of calcareous, concretionary rock, sometimes four feet thick. Below the next bridge, grey, fine, soft sandstone is underlaid by reddish, argillaceous sandstone and light grey, rusty spotted, massive sandstone, often exhibiting a very steep dip, and apparently separated from the Devonian by a fault. Lower down the rocks are nearly horizontal, and although generally too shaly they contain many beds fit for quarrying. They include at one point a ten feet layer of reddish nut-and-egg conglomerate, the larger pebbles of which seem to be principally of Carboniferous sandstone, with a few of Devonian rocks. Many of the smaller fragments are of red hematite, while the paste is a calcareous, coarser grit, with many particles of hematite. Overlying this conglomerate are reddish soft flags which produce a bright red soil. Some of the shaly, marly sandstone and conglomerate lower down are soft enough to be ground up by the fingers, resembling in this respect the Triassic. Similar rocks, with a large proportion of red, extend to tide-water at Durham, but are seen only at intervals. On the left bank, below the head of the tide, certain grey beds have been mined for copper ore.

Hematite.

Durham.

Copper ore.

Cuttings in the road along the west side of the river north of Durham expose light grey fine sandstone, containing hard spherical masses and patches of calcareous conglomerate, marked as usual by carbonized plants. In Quarry Brook there is exposed a great thickness of grey rocks, overlaid by reddish-grey sandstone and shale: they resemble the rocks of Roaring Bull and Quarry Island, and above the bridge they include thick beds of coarse grit and calcareous concretionary limestone-conglomerate, and pass downward into red rocks; while in the brook to the westward, and also towards Millsville, are fine outcrops of coarse conglomerate.

Four Mile Brook.

In the rocks which immediately overlie the conglomerate in Four Mile Brook, explorations have been made for coal; they are grey and reddish and brownish fine sandstones, marked with plants, marls and limestone-conglomerates, passing into a fair limestone. The south-easterly dip of the grey rocks of Four Mile Brook beneath the conglomerate of Greenhill, the dip of the grey rocks against the Devonian at Six Mile Brook and Saltsprings, the contact of the conglomerate of Watervale with the Devonian, and of the rocks of West River station with flinty Middle Devonian slates, seem to indicate the existence of an immense dislocation along the river, with an upthrow on the east side.

Faults.

**Six Mile Brook.**

**Tombstone quarries.**

Rocks similar to those of Four Mile Brook are found in Six Mile Brook, the bands of concretionary limestone-conglomerate being here seldom more than two feet thick and very variable; but the conglomerate does not everywhere intervene between the felsitic rocks of the mountain and the brownish and grey sandstones, which again may indicate a fault. There is a considerable belt of country in which no rocks are seen. At the head of the main branch of this brook are felsitic rocks, unconformably overlaid by coarse conglomerate, succeeded at the head of the settlement by grey, soft, glistening sandstone, upon which are situated the quarries worked by Messrs. Elliott and McPherson. On the flanks of the hills are large blocks of limestone-conglomerate; and the low land underlaid by these Permian rocks in Brookland settlement is fertile and productive.

**Saltsprings.**

Between Saltsprings and Ten Mile House, grey sandstone is abundant; and grey sandstone and conglomerate north of Saltsprings and towards Dalhousie Mountain; the conglomerate is sometimes very calcareous and appears in cliffs in the clearings on the mountain and towards Loganville, some of the pebbles being of reddish fine grit, apparently Carboniferous. In the brook near the manse at the Saltsprings, are good outcrops of grey, rusty-weathering, fine, jointed sandstone, full of fragments of carbonized plants and of trunks of trees converted into coal. Below the bridge and as far as the river, grey shales, full of comminuted plants and pebbly patches are associated with red rocks.

**Limerock.**

In Limerock Brook, red soft marls dip up stream at a low angle to a bridge on a farm road not far above West River. Above it, coarse conglomerate, largely composed of pebbles of soft sandstone, derived from the millstone grit or Lower Carboniferous, comes against grey and greenish-grey, shattered, rubbly sandstones, nearly vertical and probably belonging to the same series as the limestone at the quarry.

**Truro road.**

On the Truro road past Saltsprings, are outcrops of grey and bluish-grey sandstone and argillaceous shale, associated, further west, with reddish soft sandstone, grit and conglomerate, and perhaps Permian. They have however in the meantime been included with the Carboniferous.

**Toney River.**

The rocks of Caribou, Toney and other rivers of the vicinity, are probably of this age, the brooks running east and west for long stretches nearly on the strike. They consist of rocks similar to those described above : they are perhaps best exposed in the Black River; but outcrops are also seen on the roads throughout the district. At Sundridge, Rogers Hill and other places, are gre masses of concretionary limestone. Much of the country unde laid by the grey rocks is more or less barren or covered wit second-growth, with large marshes and meadows along the river

Hardwood Hill.

At Hardwood Hill, a boring in search of coal was made with th diamond drill through 700 feet of grey fine sandstone.

East Branch River John.

In the Black River, or east branch of River John, for a mil and three-quarters above the fork of the west branch, grey an brownish rocks are exposed, with an inclination which seldo exceeds 30°. Then similar rocks show signs of a fault; they ar grey and reddish, evenly bedded, flaggy sandstones, brownish fin sandstones, always soft, with a few layers of reddish, crumbl argillaceous shale. Above the bridge, greenish and grey san stone, coarse and pebbly, blackened by carbonized plants, is unde laid by eight feet of conglomerate : some of the bands have bee quarried. Higher up, a grey, argillaceous, impure limestone, abou two inches thick, is found among dirty greenish argillaceous shale and flags, cut by a lenticular vein of calcspar, one inch thick, holdin

Albertite

a small quantity of albertite. At the second bridge above, simila coarse rocks are found, one of the bands of conglomerate being 2 feet thick and containing a few pebbles of hematite; and, half mile higher, dip at a high angle; above which no rocks appear i the main river. The ridge of grey sandstone which follows th north side of Black River, resembles that of Hardwood Hill.

Plainfield Brook, above its confluence with Black River, show reddish, soft, marly sandstone, with a vein of calcspar half an inc thick, interstratified with dark grey and greenish flaggy sandston and pea-and-nut conglomerate, to the Earltown road; above whic grey and reddish flaggy and thick bedded sandstone and red mar

Fault.

are exposed at a fault, and succeeded by alternations of marl, sandstone and coarse conglomerate. Coarse and fine rocks in confuse bedding extend up to a fork, at which a band, apparently ten fee thick, crowded with plants and rootlets, is in place, blackened wit

Copper mines.

coaly matter, contains nodules of copper glance, and has bee worked. Up stream, grey, greenish-grey and reddish-grey sandstone and marl include layers of coarse calcareous conglomerate which soon replaces the finer rocks.

Waugh River.

Sections of these rocks in the west branch of River John and i Waugh River have been already given, and the tributaries o course expose only the same strata. About 450 yards below Bailey's bridge, at which the last of the igneous rocks of the mountain are exposed, Sutherland Stream displays a bank o reddish and brown fine Permian sandstone, with a low northerly dip, the thick conglomerate of Waugh River being entirely absent. Red sandstone and marl, with cream-coloured blotches one foot in diameter, and other fine rocks, showing comminuted plants, spotted sandstones and sandstones which have been quarried, extend to the Four Mile Brook.

In Biz (Sam Waugh's) Brook, the red sandstone and shale of the upper part of Waugh River section are well exposed, often on the strike. Above the mill-pond is a band of reddish-grey coarse grit which resembles that quarried on Waugh River at the Telegraph road.

French River.

In French River there is presented a good section of rocks which apparently belong chiefly to the middle group. It begins, like that of Waugh River, at Tatamagouche Harbour, and extends to Tatamagouche Mountain. In these beds Sir J. W. Dawson discovered *Endogenites*, *Calamites*, *Stigmaria*, branching fucoids, *Spirorbis*, scales of ganoid fishes, reptilian foot-marks, and other indications of terrestrial and littoral life.* The strata are as follows :—

Fossils.

SECTION OF PERMIAN ROCKS IN FRENCH RIVER IN DESCENDING ORDER.

Quarries.

| | Ft. | In. |
|---|---|---|
| 1. Reddish and reddish-grey sandstone and marl with greenish streaks. Includes one bed of fine brown sandstone that has been quarried. The same as No. 1 of Waugh River section. Extends to the bridge on the shore road. Dip 51° < 6° | 68 | 0 |
| 2. Reddish-grey fine sandstone in thick beds; interstratified with reddish and brownish shale with greenish layers and streaks. Bands both at the top and bottom have been quarried | 234 | 0 |
| 3. Measures for the most part concealed, but consisting chiefly apparently of red rocks as above. Dip 32° < 9° | 733 | 0 |
| 4. Red marl and sandstone to the mouth of the Millbrook, well exposed in cliffs above the iron bridge near the mouth of the Lake Stream | 609 | 0 |
| 5. Red sandstone and marl, the former largely preponderating; in thick beds, generally fine, but with a coarse layer towards the top. Green blotches. The sandstone has been quarried near the top | 267 | 0 |
| 6. Greenish, marly, concretionary rock, for the most part argillaceous and crumbly or shaly, but including harder bands of concretionary rock and of sandstone. In the soft places are many nodules of clay and calcareous sandstone and of pyrite, copper ore and albertite mixed; these are seldom as large as a hen's egg. The coal adheres to the nodule of pyrite, and is sometimes half an inch thick. Towards the top the shales become more bluish-grey. They yield no fossils except comminuted plants | 12 | 0 |

Copper ore and coal.

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*Acadian Geol., p. 217; Geol. Jour., London, vol. I., p. 326.

Coal and copper ore

| | Ft. | In. |
|---|---|---|
| 7. Reddish and brownish, thick-bedded, fine sandstone, alternating with red marl, with patches of concretionary limestone-conglomerate. Dip. 0° < 9° | 310 | 0 |
| 8. Red sandstone and marl, with bands of concretionary limestone-conglomerate from a foot downward. Much of the sandstone is coarse and pebbly, but some thick bands are fine, of a good colour, and fit for quarrying | 258 | 0 |
| 9. Red sandstone and marl, with a band of reddish concretionary limestone-conglomerate, and another of reddish-grey, pebbly grit or fine conglomerate | 437 | 0 |
| 10. Grey and greenish, shaly, fine sandstone, weathering white | 5 | 0 |
| 11. Greenish concretionary limestone-conglomerate, full of prostrate trees, the trunks of which are carbonized and coated with copper ore | 2 | 0 |
| 12. Red sandstone with greenish layers and one band of coarse grit, alternating with red marl. To iron bridge on a good road | 134 | 0 |
| 13. Red sandstone and marl, with bands of reddish and grey, spotted; some argillaceous and concretionary, greenish, thin layers. A band of sandstone near the top has been quarried. The upper part is fine, but somewhat light in colour, the lower part is of coarse grit. Dip 0° < 12° | 970 | 0 |
| 14. Brownish thick-bedded sandstone mixed with grey rusty-weathering sandstone, containing patches of coarse grit, marked with trunks of trees, the bark of which has become coal, mineral charcoal, pyrite and copper ore. The streaks of coal, &c., seldom exceed one-eighth of an inch in thickness. In one nodule, however, two inches thick, the pyrite occupies nearly the whole of that thickness, and is separated from an outside layer of coal by one-twentieth of an inch of grey copper, the coal being little thicker. All the ore, perhaps, comes from one of the concretionary bands so common in these rocks, in which small nodules and grains of limestone are mixed with particles of sand and gravel, the rock being, in places, nearly a pure limestone, in others a grit or sandstone. The coaly matter in certain grey sandstones appears to be in true veins. A tunnel [Gilpin's Mines of N. S.; Poole, Report of Commissioner of Mines for 1877, p. 48] has been driven thirty feet or more to cut the ore at this mine. Included in the preceding: apparently two feet of ore-bearing rock | ... | . |
| 15. Reddish and brownish, fine, shaly sandstone, with red marl and a patch of concretionary limestone-conglomerate. Also reddish and grey, soft, argillaceous sandstone, with whitish yellow blotches and dark stripes. Dip 356° < 12° | 540 | 0 |
| 16. Greenish and reddish, coarse, pebbly grit, with layers of nut-and-egg conglomerate, underlaid by alternations of grey, fine, flaggy sandstone, of greenish and reddish, concretionary, nodular marl and of reddish sandstone and marl. One bed of brown sandstone shows a patch spotted with copper ore in spherical spots about the size of a pea. Underlaid by light grey sandstone, | | |

| | | Ft. | In. |
|---|---|---|---|
| | fine and marked with carbonized plants, below which are alternations of grey and reddish-grey, soft, calcareous, fine sandstone, crumbly, coarse grit and bands of reddish, greenish or grey nut-and-egg conglomerate, largely composed of the waste of the silvery slates which underlie. Like the conglomerate of River John near the confluence of the west branch.................. | 346 | 0 |
| 17. | *Pre-Carboniferous*. Grey and greenish, compact and slaty felsitic rocks seen immediately below the bridge at New Annan....... | .... | |
| | Total thickness of Permian rocks................ | 4,925 | 0 |

This thickness is greater than that given by Dr. Ells,* the observed dips being much higher than his assumed angle of 7°.

Wentworth.

The similarity of many of the coarse beds to the Lower Carboniferous will be at once noticed; and it is not improbable that in districts in which the two come together they may be confounded. In the brooks below Wentworth station, the rocks are perhaps of this age, particularly if those of the Millbrook belong to the conglomerate. They are grey, whitish-grey, reddish and brownish sandstones, like those which overlie the conglomerate, towards Tatamagouche and Pictou, containing masses of reddish calcareous limestone-conglomerate. They show plates and radiating concretions of baryte in the joints, and many carbonized plants. Some of the beds are of considerable thickness and have been quarried. In other parts, the fine, evenly-bedded flags are not more than one-eighth of an inch thick. About ninety yards below the confluence of two little branches of Whetstone Brook the dip is 0° < 81°, indicating a fault.

### 3.—Upper Permian Group.

The rocks of this group are well exposed on the coast at several points between Pictou and Wallace Harbours. One of the sections already given includes these beds in the neighbourhood of Cape John, where they seem to occupy a broad syncline with a westerly inclination, on both sides of which limestone appears; and a section from Cape John eastward to Toney River may be given for comparison with it as follows:—

### SECTION OF PERMIAN ROCKS ON THE SEA SHORE BETWEEN CAPE JOHN AND TONEY RIVER IN DESCENDING ORDER.

1. Indian-red sandstone and marl, with thin lenticular layers of greenish, fine, calcareous, concretionary sandstone. One band of good brown sandstone, three ft. thick, and another of reddish

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*Geo. Surv. of Can., An. Rep., 1885, vol. I., p. 13 E.

| | | | Ft. | In. |
|---|---|---|---|---|
| | | pebbly sandstone, which forms a point. Dip nearly horizontal | 50 | 0 |
| | 2. | Grey concretionary limestone. Seen again in a brook about a mile from the shore. No. 3 of River John section | 1 | 0 |
| | 3. | Green marl | 0 | 6 |
| | 4. | Red marl and sandstone, with two lenticular layers, two inches thick, of greenish, fine, calcareous sandstone. Dip 306° < 4° | 74 | 0 |
| | 5. | Green marl, with nodules of limestone | 1 | 6 |
| | 6. | Red marl and sandstone | 28 | 0 |
| | 7. | Measures concealed at a long pond | 32 | 0 |
| | 8. | Red marl and sandstone. A reddish or brown sandstone—a good building stone, but spotted in places with carbonized plants. Dip 306° < 5°. | 103 | 0 |
| | 9. | Greenish and grey fine sandstone, with large, brown blotches, showing markings of plants converted into a grey or red copper ore which, on decomposing, stains the rock bright green. Underlaid by a considerable thickness of brownish, fine, thick-bedded sandstone, with large blotches of greenish and reddish-white, concretionary, coarse sandstone, full of threads of calcspar; false-bedding. Towards the bottom, the reddish sandstone is coarse and contains light grey and greenish patches. The estimate of thickness is somewhat vague, the dip being variable. Forms a prominent cape | 70 | 0 |
| | 10. | Reddish shaly sandstone and marl, not continuously exposed | 149 | 0 |
| | 11. | Red sandstone and marl, with greenish and grey spots and layers | 103 | 0 |
| | 12. | Red sandstone and marl, not well seen, with one or more layers of grey, coarse sandstone. The beds are undulating, and the thickness given is perhaps too great | 57 | 0 |
| | 13. | Measures concealed at a little pond | 75 | 0 |
| Coal and copper ore. | 14. | Grey, fine and coarse, pebbly sandstone, with spots coloured yellowish, blackish and green by fossil plants, near which occurs a large quantity of coaly matter and of copper ore | 4 | 0 |
| | 15. | Red shaly sandstone and marl, including fifteen feet fit for quarrying, and occasional thin, green layers | 212 | 0 |
| | 16. | Indian-red, chocolate brown and grey sandstone, with some beds of marl, but for the most part brown sandstone, much of it fit for quarrying, and like the brown stone of River John; in part coarse and pebbly, passing into conglomerate. The grey beds are spotted and concretionary. To the lobster factory | 190 | 0 |
| | 17. | Red marl and sandstone, the latter in flaggy or thick beds, some of which are fit for quarrying. One band of fine, brownish sandstone, fifteen feet thick. To a large brook north of Cape John post office. Not continuously exposed. Here the dip, after undulating somewhat, changes to 3° < 6° | 172 | 0 |

| | | Ft. | In. | |
|---|---|---|---|---|
| 18. | Red sandstone and marl more nearly on the strike. Some of the beds of fine grain; greenish layers; two bands of grey and reddish pebbly sandstone, the uppermost underlaid by a considerable thickness of dark bluish-grey argillaceous shale. These are on opposite sides of a large brook, one mile and a-quarter south of the last and half a mile from the end of the measurement. Dip $3^\circ < 7^\circ$. On the lowest beds two openings have been made to quarry stone in three benches aggregating ten feet; some of this stone is very good | 305 | 0 | Quarry. |
| 19. | Red marl with bands of fine sandstone, shaly and in thick beds; and masses of reddish and greenish limestone-conglomerate; greenish layers and blotches, often pebbly, sometimes concretionary. To a quarry on a small headland more than a mile from the last | 160 | 0 | |
| 20. | Red sandstone and marl with a large proportion of sandstone. Some beds rough and occasionally greenish or grey with fossil plants. Too coarse, spotted and concretionary for quarrying. To a little brook. Dip $0^\circ < 10^\circ$ | 126 | 0 | Fossil plants. |
| 21. | Grey and greenish-grey, fine and coarse, pebbly sandstone, with carbonized plants; yellowish-weathering; bands of concretionary limestone-conglomerate; layers of reddish coarse conglomerate and sandstone and fifteen feet of fine and coarse brown sandstone | 69 | 0 | |
| 22. | Reddish and brown, fine, shaly sandstone underlaid by greenish fine sandstone with concretionary layers; rusty-weathering, passing in patches into conglomerate; underlaid again by red shales. To the mouth of Toney River | 320 | 0 | Toney River. |
| 23. | Rocks seen at intervals on the coast as far as the lobster factory one mile and three-quarters from Toney River. Reddish and greenish mottled sandstone, brownish, shaly, fine sandstone; grey, greenish and brownish coarse sandstone, with many carbonized plants in the bedding; bands of reddish and greenish limestone conglomerate and, at the base, red marls. The estimate is, of course, vague | 320 | 0 | |
| 24. | The rocks of Toney River, consisting largely of grey sandstones appear to underlie these directly and at a distance of about 2,000 feet, ($< 14^\circ$) is the coal which has been worked. Immediately beyond it there seems to be a fault | 2,000 | 0 | Coal. |
| 25. | Coal of Toney River—a small seam cut in several shafts | .. | .. | |
| | Total thickness | 4,622 | 0 | |

Search for coal.

The importance of a carefully compiled general section of the Permian rocks for comparison with the strata cut in the many deep borings made in search of coal in the region is very great. The shore between Cape John and Pictou Harbour, probably gives the most continuous section, to which might be added data from some of the rivers.

Sea shore west of Pictou Harbour.

The east and west anticline, complicated apparently with a fault, the axis of which seems to strike the shore of Pictou Harbour between Logan and Cole points, apparently brings the higher rocks out on the eastern end of this peninsula. On the west side of a deep cove north of Pictou, into which comes a little brook from McKeen's quarry, reddish and grey coarse flags dip 146° < 13°. About 300 yards inside the tip of Loudon Beach is a bank of reddish fine shale and flaggy sandstone, with a very low dip, probably southeasterly. At the base of this beach are other obscurely dipping red rocks. At Cole Point, bluish and greenish-grey coarse and fine sandstone, in low irregular bedding, forms reefs. Then follows a wide cove with a small pond inside; at the mouth of the little brook from this pond, reddish fine sandstone dips at a very low angle; at the western side of the cove, greenish-grey, coarse and fine, rusty weathering sandstone, dips 123° < 4°; and similar rocks, tinged with red, occur at intervals for some distance and are succeeded by red marl in a bank and by red, coarse and fine sandstone in reefs. On these reefs at Logan Point, at a strong spring from the bank, good exposures dip about 32° or somewhat more easterly at a very low angle. At the mouth of Graham Brook, the soil is bright red, and reefs of red shaly sandstone, with green blotches, lie horizontally. For about a mile the shore is sandy and bouldery as far as the lobster factory on the west side of Widow Point, immediately beyond the gut at Doctor Spit; then for half a mile the bank shows large blocks of reddish, crumbly, coarse grit to a deep broken marshy bay, immediately beyond which reddish, coarse sandstone on reefs seems to dip 352° < 10°. At the point half a mile distant are outcrops of reddish-grey, coarse, pebbly, false-bedded grit, nearly horizontal, but with a possible dip north of east; and in a little cove beyond, thick beds of coarse grit dip 312° < 7°. For the next mile and a-quarter blocks of grey usually fine sandstone abound, with one outcrop, however, nearly horizontal; then grey, coarse sandstone dips 22° < 10°, but immediately past a broad point with a large marsh and pond, greenish and grey thick-bedded sandstones dip 93° < 21°, changing at a few feet to 112° < 5°, and succeeded, at 300 yards further, by greenish-grey, more or less impure limestone, striking 7° with apparently a low easterly dip, interstratified with red marl and sandstone. The outcrops nowhere exceed a few yards in width, the gaps being wide; and nearly a mile east of the Millbrook, even these cease and the shore is low nearly to the mouth of Caribou River, east of which a band of limestone, about nine inches thick, dips 347° at a very low angle.

Limestone.

Caribou River.

For 400 yards up Caribou River,* reddish and greenish shales in broken banks dip seaward; at 950, grey, fine, flaggy sandstone, dipping 29° < 5°, is succeeded by red rocks. About 150 yards above the bridge on the shore road, grey coarse and fine, rusty-weathering, crumbly sandstones dip 40° < 18°; but with this exception no rocks are found on the left bank for a considerable distance. Then above a little brook at a marsh and lagoon, large blocks of a cream-coloured and whitish compact sandstone and pebbly grit are associated with blackish, coarse, crumbly rocks. It is like a volcanic ash or claystone, and is perhaps in part of volcanic origin. At the copper mine, on the left bank of the river, a large quantity of coarse conglomerate is found with the usual association of pyrite, lignite and grey copper ore, with trunks of trees, apparently underlying the coherent grit mentioned above. Some of the pebbles of the conglomerate are as large as cocoanuts; among them are several of red hematite, and this mineral coats the polished surfaces of many of the pebbles. The conglomerate band is interstratified with dark sandstone and coarse grit, dipping at a low angle into the bank and found at the pits sunk on the little brook above, one of which is said to be ninety feet deep and to have passed through copper ore, but no coal. Thence the conglomerate appears to run to the neighbouring house, to cross the grassy road about half a mile north of its junction with the main road, and to extend on this course for a mile further. North of it on the road the strata are principally red and clayey.

Igneous rock?

Copper mines.

Caribou Island.

On the shore west of the ford to Big Caribou Island, the exposures are good. They consist of reddish, grey and mottled, crumbly sandstones and shales; the grey being often coarse and pebbly, with rusty patches, carbonized plants and streaks of pyritous coal. Among the red are green blotches and layers of conglomeratic rock, passing into impure concretionary limestone. In some of the beds of grey friable sandstone and conglomerate, west of the mouth of Toney River, are coaly streaks, sometimes an inch thick, with large crystals and crystalline aggregations of pyrite; and in one of them is a black streak composed of grains of magnetite. The limestone shows obscure fossils, perhaps small corals, cone-in-cone and other concretions.

Point Brulé.

On the outermost reefs of Point Brulé, reddish, soft, crumbly shales dip 202° < 5°, including a half-inch green band, and overlaid by reddish and grey sandstone in six-inch flags or in thicker beds fit for building stone, but containing "bulls-eyes" and patches of conglomerate. Further west, a greenish-grey, coherent, conglomeratic limestone is marked with fossil plants; beyond which rocks chiefly red, dip 141° < 5°, and contain layers of greenish, coherent, compact sandstone marked with plants, and red and green marl with nodules of limestone, among other beds fit for building stone. About half a mile south of Peninsula Point, red sandstone and marl, with green calcareous layers and concretionary limestone-conglomerate, dip 137° < 5°, and are well exposed, with occasional bands of grey sandstone, to the beach along which the road follows. On this beach and for a great distance to the westward, blocks of reddish and grey sandstone are found; then at a bluff point, reddish greenish and grey sandstone dip apparently to the south-eastward at a very low angle. Not far east of the Narrows of Barachois Harbour, red and brown sandstone, flags and shales dip 97° < 7°, and nearer the Narrows, 67° < 3°, red marl being the prevailing rock. On the west side, above the mouth, red marl and sandstone dip 87° < 7°. From the mouth of the Barachois, a high bank of red marl follows the western shore, with two bands of greenish marl not far apart, the uppermost, six inches thick, being an impure knobby limestone, the lower, more than a foot thick, consisting of layers of shaly sandstone and red marl. Further north are blocks of grey and reddish coarse grit. At the north end of Chambers Point are blocks which may indicate the presence of the Cape John limestone. About a quarter of a mile to the westward, reddish, wavy, shaly sandstones, dipping 136° < 5°, are followed by red flags which dip 157° < 5°, some of which are fit for quarrying. And about half a mile further, beds of coarse crumbly sandstone, of a brick red decidedly Triassic colour, like the rocks at the mouth of Graham Brook, still dip south-easterly, and are succeeded by cliffs of reddish and greenish coarse and fine sandstone, in thick rough beds. It is about three-quarters of a mile north-east of the sand-beach and grassy point at the mouth of Tatamagouche River, near which a whitish-green calcareous sandstone, a foot thick, interstratified with red sandstone and marl, dips 140° < 4°. About a mile up the river, at the end of a road to the shore, red or brown sandstone in a quarry at the cliffs dips 71° < 5°.

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*Acadian Geol., p. 327; Supplement, 1878, p. 36.

Limestone.

Tatamagouche.

The rocks of the neighbourhood of Tatamagouche have been described in the two sections of Waugh and French rivers. West of Blockhouse Point are outcrops of red marl with patches of concretionary limestone, light grey, fine, micaceous sandstone, with "bull's eyes," false-bedded, containing carbonized trunks of trees and traces of copper ore, and reddish-grey, coarse, pebbly sandstone.

The shore at the head of Tatamagouche Bay is low. On the Telegraph road, immediately beyond the bridge on Dewar River, indian-red, crumbly sandstone and marl dip 177° < 15°, and are marked with fucoids and what resembles the foot-prints of an animal. The rocks resemble Permian strata, but are also similar to the red Carboniferous rocks of Great Village River.

Fossil foot-prints.

A ridge follows the middle of the peninsula towards Malagash Point, and south of this runs a ledge of grey sandstone which has been quarried near a little brook which flows westward across the first road north of the shore road, where the dip is apparently 179° < 52°. The sandstone at the quarry is a grey, fine, thick-bedded variety, marked with broken carbonized plants. A short distance further east red shales dip 167° at a high angle; and the soil has a Permian aspect as far as the road to Scott's Island, on the most southerly point of which are ledges of reddish fine sandstone, seen only at low water; and, on the south-east point, fine grey sandstone and greenish conglomerate.

Malagash.

Down Dewar River and along the shore to Scott's Island, no rocks are exposed; about half a mile further east, however, red, evenly bedded flags and shales dip 160° < 10°, and include a band of from one to six inches of calcareous concretionary conglomerate and irregular layers of grey, fine sandstone which contains carbonized plants and traces of green carbonate of copper, which has been worked in the bank. The rocks cannot be distinguished from the Permian of the shores of Brulé.

Copper mine.

A few yards further east the angle of dip is lower, and brown sandstones, in beds one foot thick, are fit for building, but in low banks. Then come red marly rocks, like those seen on Scott's Island, near Stewart's house, with a very low northerly dip, changing immediately beyond to 112° < 60°, but possibly broken in the bank, for a few yards further the dip is 142° < 15°; and 180 yards further, brown soft sandstone lies at a low angle. Then a sand beach, with a minute pond inside, occupies the shore for half a mile, and is followed by a sandy cove at the head of which the road comes to the shore, and past it is an obscure outcrop of grey fine sandstone, blocks of which are found as far as the brook or lagoon opposite the Methodist church at Malagash. East of the lagoon, ledges of shale, like that south of Scott's Island, dip 162° < 50°, and, at the east end of the outcrop, at a lower angle. Stretches of marsh and sand then reach nearly to within a mile of Malagash Point, where reefs of grey, bluish-grey, greenish-grey and reddish sandstones dip 157° < 20°, the angle soon increasing to 44°. The bedding of the sandstones is rough, few of the layers being fit for quarry-

Copper mine.

Limestone.

Coal.

ing; they include patches of conglomerate, concretionary limestone and rusty spots, full of carbonized plants, sometimes of large size. Beneath them lie red marls and shaly sandstones, with a band of reddish-grey spotted sandstone and a reef of reddish pebbly grit, like rocks of Toney River, dipping 150° < 41°. At the Cape, a bed of greenish-grey coarse sandstone has a concretionary patch at the bottom, which holds a little copper ore; it dips 151° < 68°, among greenish and purplish papery shales, coarse, grey and reddish crumbly grit, marly beds, with nodules of limestone and layers, two or three feet thick, of bluish-grey limestone, veined with calcite, like the limestone of Caribou, Cape John and Pictou Island. Immediately to the westward, the red sandstones and shales include layers of greenish and reddish, spotted, crumbly sandstone; and on the cliffs at the lobster factory two pits cut a concretionary band streaked with copper ore; almost in contact with which is a seam of coal, at best ten inches thick, but generally interrupted by clay bands, supported by several feet of underclay, underlaid by a thick bed of coarse and fine grey sandstone, with rusty, carbonized plants, and by red sandstone and marl to the marshes of Purdy Island.

The following descending section of these rocks is given by Sir J. W. Dawson*:—

Fossil plants.

| | Ft. | In. |
|---|---|---|
| 1. Brownish red sandstones and shales, alternating with grey sandstones, one of them containing pebbles of white quartz, about.. | 600 | 0 |
| 2. Dark grey limestone.................. | 2 | 0 |
| 3. Grey and reddish sandstones.................. | 50 | 0 |
| 4. Dark grey limestone.................. | 3 | 0 |
| 5. Grey sandstones.................. | 50 | 0 |
| 6. Reddish sandstones and shales ..................not well seen | | |
| 7. Grey arenaceous shale: fern leaves and *Cordaites*.............. | 6 | 0 |
| 8. Underclay with *Stigmaria*, and an erect stump with *Stigmaria* roots, penetrating the bed above.................. | 3 | 0 |
| 9. Dark grey limestone.................. | 3 | 0 |
| 10. Alternations of grey and reddish sandstone and shale; in the lower part a bed of coal six inches thick, with *Stigmaria* underclay, about.................. | 300 | 0 |
| 11. Grey sandstone.................. | 20 | 0 |
| 12. Alternations of reddish sandstone and shales and grey sandstone, with thin layers of clay ironstone and a layer of coaly shale, about.................. | 300 | 0 |

Saddle Island.

Immediately to the north lies Saddle Island, the north side of which is all rocky; and not far from the west end, grey, thick-bedded sandstones, with rusty spots, dip 349° < 60°. They are of every variety, are interbedded with greenish argillaceous shale and underlaid by reddish sandstone and shale, with layers of greenish papery shale, which dip, at the eastern point, 347° < 60°. At the western point the highest beds of grey sandstone dip 342° < 60°, and seem to strike in a line for Amet Island. One band is of good grindstone grit and another of grey limestone-conglomerate.

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*Acadian Geol., p. 215.

From the west end of the island, sand flats, for the most part dry at low water, extend 217° to the mainland. At this point grey flags, with pebbly patches and concretionary limestone-conglomerate, dip 348° < 55°, and are overlaid by grey sandstone and shale, the former containing many pebbles of white quartz, and a band of limestone-conglomerate which may be that of Saddle Island. Then grey sandstone occupies the coast for a great distance, associated with a reef of grey calcareous shale, with coherent limestone and five feet of reddish and greenish, pebbly, concretionary rock, which carries a little copper ore at the bottom, with traces of coal. About half a mile east of a lobster factory, the dip is 345° < 82°; at and for a quarter of a mile east of the factory, vertical rocks strike 287°; and the next rocks met with, beyond a point and long sand beach, belong to the Carboniferous limestone already described (page 102), which is, however, interrupted further west by unconformable outcrops of the Permian.

Contact with Carboniferous

The coal of Cape Malagash and that of Caribou Island seem to be higher than that of Little Harbour, Merigomish Island and Toney River, and it does not seem probable that any of the seams are continuous. Two borings were made on Caribou Island, and the strata cut by them will be seen in the following record kept by Mr. Fraser, No. 2 lying north-west from No. 1.

Caribou Island.

Besides the borings with the diamond drill made at this and other localities in these rocks, and already mentioned, one at Logan's tannery, of 1,000, and two at Lyons Brook, of about 500 feet each, were made by Mr. Fraser.

SECTION OF STRATA IN BORE-HOLE NO. 1, CARIBOU ISLAND.

Cut by diamond drill, March, 1875.

| | Feet. | Inches. |
|---|---|---|
| 1. Surface | 15 | 0 |
| 2. Freestone | 4 | 0 |
| 3. Red pencil rock | 49 | 0 |
| 4. Freestone | 60 | 0 |
| 5. Soft dark pencil rock | 9 | 0 |

| | | Feet. | Inches. |
|---|---|---|---|
| 6. | Red soft pencil rock | 23 | 0 |
| 7. | Fire-clay and pencil rock | 13 | 0 |
| 8. | Pencil rock | 6 | 0 |
| 9. | Freestone | 8 | 0 |
| 10. | Grey hard, coarse freestone | 5 | 0 |
| 11. | Red pencil rock | 5 | 0 |
| 12. | Grey fine freestone | 11 | 0 |
| 13. | Speckled freestone and pencil rock | 6 | 0 |
| 14. | Red pencil rock | 56 | 0 |
| 15. | Freestone | 31 | 0 |
| 16. | Red and dark pencil rock | 9 | 0 |
| 17. | Red pencil rock | 28 | 0 |
| 18. | " " | 36 | 0 |
| 19. | Red pencil rock and marl | 15 | 0 |
| 20. | Red pencil rock | 18 | 0 |
| 21. | Red sandstone | 10 | 0 |
| 22. | Red pencil rock | 25 | 0 |
| 23. | " " | 27 | 0 |
| | Total depth | 469 | 0 |

SECTION OF STRATA IN BORE-HOLE NO. 2, CARIBOU ISLAND.

Cut by diamond drill, April, 1875.

Coal.

| | | Feet. | Inches. |
|---|---|---|---|
| 1. | Surface | 20 | 0 |
| 2. | Sandstone | 7 | 0 |
| 3. | White coarse sandstone | 20 | 0 |
| 4. | Grey fine sandstone | 8 | 0 |
| 5. | Grey mixed rock-conglomerate | 4 | 0 |
| 6. | Coal [Acadian Geology, p. 343] | .. | 7 |
| 7. | Fire clay | 15 | 2 |
| 8. | Red pencil rock | 8 | 0 |
| 9. | Red very soft pencil rock | 4 | 0 |
| 10. | Red pencil rock | 1 | 0 |
| 11. | Fire clay | 7 | 3 |
| 12. | Red pencil rock | 13 | 0 |
| 13. | Fire clay | 2 | 0 |
| 14. | Brown freestone | 10 | 0 |
| 15. | Grey freestone | 15 | 0 |
| 16. | Red pencil rock | 2 | 0 |
| 17. | Red sandstone | 18 | 0 |
| 18. | Limestone-conglomerate and red pencil rock | 21 | 0 |
| 19. | Red pencil rock and clay | 27 | 0 |
| 20. | Red pencil rock and beds of clay | 9 | 0 |
| 21. | Brown freestone | 19 | 0 |
| 22. | Grey freestone | 19 | 0 |
| 23. | Fire clay | 4 | 0 |
| 24. | Red pencil rock | 209 | 0 |
| | Total depth | 463 | 0 |

Pictou Island.

Sections comprising 500 or 600 feet of these rocks, with a limestone near the middle, probably about the horizon of that of Cape John, are well exposed on the shores of Pictou Island and have been described by Principal McKay.* They dip north and south at a low angle from an anticlinal axis which runs about 84° from end to end of the island. A large proportion of the strata is of grey sandstone of the usual variety, certain beds of which have been quarried for grindstones.

### H.—TRIASSIC.

Distribution.

Although Dr. Ells has excluded from the Triassic,†-as not clearly distinguishable from the Permian, the rocks referred to this series by Sir J. W. Dawson in Prince Edward Island, he has retained the areas which "are found at intervals along the shores of Minas Basin.‡ They extend for the most part but a short distance inland and have their greatest development in the neighbourhood of Truro and for ten to fifteen miles west. East of that town they occupy the valley of the Salmon River for about six miles and extend northward to the second bridge over the North River, about four miles in a direct line from Truro. Thence they occupy the country westward along the line of the Intercolonial railway and for a short distance north, to the vicinity of the Folly River viaduct, where the contact with the underlying Carboniferous formation is seen about 500 yards above the railroad. From this point the area becomes narrower, the northern boundary gradually approaching the shore of the Basin of Minas which it reaches at Five Islands. The continuity along the coast is broken in the vicinity of Economy by areas of Lower Carboniferous sediments. Below this, towards Cape Chignecto, the Triassic formation occurs only in irregular patches upon the older rocks."

Description.

The relations of the sedimentary rocks of this formation, with their associated traps, to the older formations have also been described in great detail by Jackson and Alger, Gesner,§ Sir J. W. Dawson,‖ and others. The contact with the older rocks is always clear and unmistakable, so that there is no ambiguity with regard to the limits of the formation. Sometimes, particularly on the north side of the basin, this junction is a fault, sometimes coarse beds lie at a low angle upon, and fill inequalities in, the underlying rocks of which they are composed. Many of the sandstones are very calcareous. The total thickness of the formation is doubtful.

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*Trans. N. S. Inst. Sc., vol. VIII., p. 76.

†Geo. Surv. of Can. Rept. of Progress, 1882-83-84, p. 12 E. ; Acadian Geol., Supplement, 1891, p. 10.

‡Geo. Surv. of Can. Ann. Rept., vol. I., p. 6 E.

§Geol. and Min. of N. S., p. 239.

‖Acadian Geol., p. 99; Geol. Jour. of London, vol. IV., p. 50, with a map.

Valley.

In Clifford Brook, east of Valley station, the lowest Triassic rock is a pea-and-nut conglomerate lying horizontally on the red slates of Union. On the road to the Telegraph road east of the manganese mines, and also in the neighbourhood of the mines, many pieces of Triassic sandstone are in the soil and perhaps point to outliers among the Devonian.

From the railway station at Valley across the bridge and out the road to the Telegraph road, the strata are Triassic; and to the eastward along the Telegraph road and for some distance up the river these rocks are also exposed. In Half Moon Hill Brook the contact with the Devonian is well seen, the Triassic being bright red, crumbly, coarse sandstones, scarcely more coherent than the sand of a sand pit, with layers of grit, less bright than the other beds, containing pebbles an inch in length derived from the red argillites. Lower down is a grey, crumbly, flaggy, pebbly sandstone, dipping at a low angle, with thin beds and blotches of light green.

Contact with Devonian.

Farnham's Millbrook.

In the branch of Farnham's Millbrook, which flows from Penny's Mountain, are dark brick-red, soft, marly, very fine sandstone, containing patches of grey calcareous sandstone and of coarse conglomerate, with a vertical dip which appears to indicate a fault. In another little brook further west, brick-red sandstone and nut-and-egg conglomerate form ledges which dip 177° at a very high angle.

North River.

In Smith Brook, which runs into North River near the village, coarse and fine flaggy sandstone lies nearly horizontal at the contact with the Devonian; and on the opposite side of North River, below the bridge, the contact is again seen.

In Henry Christie's millbrook, red sandstones are exposed, for some distance above the road at Valley, in nearly horizontal bedding, the coarse sandstones containing patches of soft concretionary clay or mudrock, and, near the junction of the older rocks, beds of conglomerate.

Belmont.

For a little more than a mile above the bridge, on the road at Belmont, tile or brick-red Triassic sandstones occupy the Chiganois River. They are then succeeded by a breadth of a quarter of a mile of green and grey and red shale, with patches and small seams of coal; these by half a mile of Triassic, before coming to the great outcrops of metamorphic rocks. Among the lowest beds are layers of nut-and-egg conglomerate, containing veins of calcspar, one of which is a foot thick, the pebbles being of gneissic and quartzose rock. At the mill-dam above Belmont, reddish fine sandstone, crumbly and like that of Truro, dips 191° $<$ 31°, and higher towards the saw-mill, $<$ 55°. The junction here appears to be a fault. Fault.

The dip of the frequent outcrops of Triassic sandstone seen above the railway, in Staples' Brook, is 277° $<$ 15° to 34°, and the beds are fine nearly to the bridge at the post office; where fine sandstones are succeeded by coarse sandstone and conglomerate, with a steep south-westerly dip. Staples' Brook

In Debert River these rocks extend a mile and a half above the railway; and at or near their junction with the older rocks dip down stream at a very high angle, and appear to be affected by a fault, the rocks at the base being finer and more flaggy than usual, but including bright red, crumbly, coarse sandstone and pea-and-nut conglomerate. Debert River.

The Triassic rocks of Pine Brook are well exposed above the railway, presenting as much variety as is anywhere met with. They comprise red soft sandstone, with small patches in which are pebbles as large as nuts; pea-and-nut conglomerate; brick-red nut-and-egg conglomerate, hollowed into a cave thirty feet deep; coarse sandstone and fine conglomerate, with small green blotches; red fine sandstone, massive, but with bedding planes marked by blackish streaks of magnetite, and with patches of green and grey concretionary limestone-conglomerate, seldom more than a foot thick; succeeded by the Carboniferous. Pine Brook. Cave.

In McElman Brook, the contact of the Triassic with the older rocks is at a fork about three-quarters of a mile above the railway, where brick-red, crumbly, coarse sandstone and nut-and-egg conglomerate are irregularly intermixed. McElman Brook.

In the brooks between Truro and the mouth of the Shubenacadie River at Blackrock, Triassic rocks rest nearly horizontally upon the edges of the red rocks of Union at no great distance from the shore. Those on the shore between Salter's Head near Maitland and King Creek (page 96) have been already referred to; and the prevailing low angle of dip is found in the cliffs, which are almost unbroken as far as Noel Bay, the rocks being precisely like those of Truro and Economy—essentially red coarse sandstone, with layers of greenish and grey concretionary sandstone and patches of coarse, pebbly grit. Across Noel Bay is a wide expanse of low Shubenacadie River. Noel.

dyke-land, which presents a curious picture, with its numerous stacks of hay set on high foundations of wooden piles. At Densmore's mills, flinty Devonian slates have a nearly vertical dip, and reappear at several points on the road for the next two miles to Noel village, where the Triassic extends probably to the bridge on the post-road. High unbroken cliffs extend thence round Burntcoat Head into Moose Bay, showing islands and pierced masses of the red Triassic sandstone, hardly distinguishable from the Permian of River John, but as a rule less coherent. A large proportion of the rock at Teny Cape Creek is rusty grey nut-and-egg conglomerate.

The rocks of Walton and the shores to the westward need not here be referred to.*

## SURFACE GEOLOGY.

Many points concerning the distribution of the ancient gravel ridges and beaches, the deposits of unstratified and stratified clay, sand, gravel and boulders, which cover to a variable depth the solid rocks, and indicate the action of ice and water during the Post Pliocene period, have been discussed by Sir J. W. Dawson,† Dr. Honeyman,‡ Mr. Poole,§ Dr. Ells,|| Mr. Chalmers and others.

Hogsbacks.

Pictou.

A well marked kame or hogsback, composed of coarse gravel and sand, runs from the neighbourhood of McKeen's quarry, east of Pictou, across the back road, and was traced by Principal McKay north-westward along the left bank of a little brook nearly to the seashore of Caribou, a distance of about three miles. Other banks of sand and gravel occur in this vicinity, and a remarkable number of boulders, principally of syenite, granite and diorite, are scattered over the face of the low, flat country along the strait. For a great distance below Earltown, the valley of Waugh River, which resembles a Carboniferous glen more than a valley cut out of Pre-Carboniferous rocks, contains a large quantity of drift, derived apparently from Permian rocks, everywhere along its banks; and from near Earltown to far below Mr. Gilbert Sutherland's house extends a well marked sand and gravel hogsback, broken, of course, in places, and represented in others only by

Waugh River.

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*Acadian Geol., pp. 89 and 258.

†Acadian Geol., pp. 60 to 83.

‡Trans. N. S. Inst. Sc., vol. III., p. 345; vol. IV., p. 109; vol. V., p. 325: vol. VII., p. 138, and other papers.

§Op. cit., vol. VII., p. 388.

||Geol. Surv. of Can. An. Rept., 1885, vol. I., p. 64 E.

knolls or mounds. On the south side of the river, near Donald Sutherland's house, sand and gravel are in hills and ridges. Banks of sand and gravel are also seen where the Salmon River road leaves the Earltown post-road, in the valley which follows the road from Nuttby to Waugh River, and in other valleys of the district, the drift here resembling the soft rocks which lie to the northward. Along Byers Brook and at Farmington are banks of reddish drift, composed largely of Permian debris, which is seen in other places on the northern slope of the mountain, and appears to have come from the north. The fertility of the well wooded hills and of the romantic mountain farms on this slope is in part no doubt due to its presence.

Byers Brook.

Stewiacke.

On the Stewiacke River, down the right bank from Eastville, great banks of drift gravel are seen, and at Middle Stewiacke curious mounds, apparently of gravel, the abundance of blocks of granitic and felsitic rocks, both here, at Green Creek and at Shubenacadie River, being as remarkable as in the neighbourhood of Pictou.

Scotsburn.

The gravel pits of Scotsburn, from which ballast was taken for the Oxford and Pictou railway, are of large extent and seem to contain only the debris of rocks of the hills lying to the southward, accumulated as it were in an old lake. The excavations show banks twenty-five feet high, containing comparatively few large boulders.

Terraces.

On the Portapique River, two terraces on the left bank show for a considerable distance opposite the post office of Montrose.

Ice grooves.

Glacial striæ were observed at the following localities:—

Pictou, [mentioned by Lyell, Travels in North America, vol. II., p. 179], 53°.

Grant Lake, on the road between the lake and the first house towards Hopewell, 192°.

Foxbrook and McLellan's Mountain (observed by Mr. H. S. Poole) 197°.

West Branch of River John near Loganville, 175°.

Hardwood Hill west of Pictou, three sets of grooves, 147°, 197° and 92°, the last being the most recent and produced probably, according to Mr. Chalmers, by the passage of ice into the neighbouring valley, whereas the others may run from the Cobequid Hills.

Folly Mountain, at the clearings near Archie Slack's, not far west of the foot of Folly Lake, 172°.

Saddle Island, well-marked, on a plane which does not face the sea, 102°.

Old Westchester Mountain road near the county-line, 162°.

Lynn, 169°.

None of the numerous bare knobs of diorite and syenite on the top of the hill on the old Tatamagouche road show ice grooves, though many of them are rounded and irregularly channelled.

Direction of the drift.

Many facts bearing upon the direction of transportation of the drift are given by the authorities mentioned above; and as the determination of this question has a practical application in prospecting or searching for mineral deposits it is of the greatest importance. Mr. Donald Fraser, of Springville, states that blocks of iron ore are most numerous north-east of the beds in Pictou county, but that the drift from the south side of the watershed of Nova Scotia went to the southward. Mr. Alex. McBean, of the Vale colliery, also maintains that the drift has gone north from the high land and that much coal debris is found north of the seams, whereas it frequently happens that the sand and gravel immediately overlying the coal seams contain absolutely no traces of coal. Late explorations made in search of coal immediately north of Logan's north fault revealed an abundance of coal-measures drift, including large blocks of coal, overlying solid red rocks of the millstone grit. And on McLellan's Brook, on the left bank immediately above the fulling mill, drift from the red rocks to the southward is so abundant that it might be supposed to indicate the rock in place were it not that the shales of the coal measures are seen at water level along the pond.

Boulders.

The numerous boulders of white-weathering syenite and granite so abundant in the neighbourhood of Pictou, Haliburton Creek, New Glasgow, Kemptown and other localities have been already referred to. The gravels of Lorne appear to be derived from Devonian slates, many of them ferruginous, and from syenitic and dioritic rocks, together with blocks and pieces of softer, newer sandstone and shale from strata underlying. In Cross Brook, among the Silurian rocks is a large boulder of Carboniferous limestone, already referred to as possibly indicating a Carboniferous outlier. Boulders of syenite and diorite, like those of the mountain to the southward, are abundant on the roads about Staples Brook and the vicinity.

The blocks of gypsum said to have been washed out of the bank at Cape John* seem to be boulders brought from a distance, as no rock of this kind is known in place in the neighbourhood. One is at the lobster factory, another, twelve feet by four feet, lies on the outer shore three miles east of the cape.

On the shores of Minas Basin, large irregular deposits of sand and gravel are met with, but will not here be described.

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*Acadian Geol., p. 327.

Raised beaches.

On both Speid and Maple Lakes, raised beaches were seen. On the north side of the former, at a little brook near the outlet there is said to be a stone weighing ten tons, perched, twenty feet high, on a pivot on another.

## IGNEOUS ROCKS.

According to their periods of formation, these rocks may be arranged in three groups, as follows:—

1. Cambro-Silurian.
2. Devonian.
3. Post-Carboniferous, principally Triassic.

These groups differ, as will be seen in the sequel, in the character and composition of their rocks, those of the last being, as a rule, much less massive, crystalline and coherent.

1. *Igneous Rocks associated with Cambro-Silurian strata.*—The igneous materials everywhere associated with Cambro-Silurian strata east of the East River of Pictou, seem to be older than the adjacent Silurian, as described in last report.*

Moose River schists.

The felspathic schists, agglomerates, porphyries, and other rocks of the neighbourhood of Moose River, require no special mention. The relation of the schists to the massive volcanic rocks is obscure; in Sutherland's River they are associated with fragmental felsites and masses of soapy, serpentinous, fragmental slate. They differ from the Cambro-Silurian slates and do not seem to be an altered form of them, but rather bedded volcanic breccias. They are greenish, pearly, scaly, chloritic and micaceous, full of veins of quartz, and intimately mixed with rocks like those of Baxter's Brook. Soapy slates and mica schists, weathering-rusty, and silvery grey, are found in the French River in the neighbourhood of Blue Mountain, containing so many large veins of quartz that in places they pass into quartzite; with blocks of felsite, hornblende-rock and diorite. In the first small brook below Patrick's are blocks of felsite, but no outcrops. Near Murdoch Lake, massive dioritic rocks are associated with felsitic schists and Cambro-Silurian grits. 250 yards north of the Blue Mountain church, is a pink porphyry, jointed and crossed in all directions, blotched with quartz and spotted with crystals of red felspar. Porphyry and diorite crop out at other points in the same neighbourhood;† and ridges of greenish and dark grey diorite, on

Quartz veins.

Blue Mountain.

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*Geol. Surv. of Can., An. Rept. 1886, vol. II., p. 99 P.

†Trans. N. S. Inst. Sc., vol. III., pp. 69, 72, 107 and 108; vol. V., pp. 67, 7 and 73.

the mountain road near the church at McLellan's Mountai Large outcrops of greenish diorite are found on the roı through the Ross settlement north of Sunnybrae, associated wi Silurian rocks and with flinty Cambro-Silurian slate; and small outcrops on Irish Mountain and towards Churchville. In Camer Brook is a dyke of dark grey amygdaloid, with cavities and veins calcspar, among greenish flinty conglomerate and black rusty Sil rian slate; and at Churchville, a trap precisely similar, coated wi hematite, perhaps cuts the Carboniferous conglomerate.

Corrimony.

The reddish traps of Corrimony, containing specks of colou less quartz, cut Cambro-Silurian rocks and also the doubtf flinty grit, which may be Medina. Near Dan Urquhart's, massi and slaty fragmental, soapy rock is associated with dark cryst line diorite, light-coloured felsite, chloritic and nacreous rock, cut l quartz veins, and with bluish-grey pyritous trap. In Glenc Brook, greenish compact diorite and felsite, blotched with quar and hematite, appear in large outcrops; and at Mount Horeb, greenish diorite cuts ribbanded slates; and purplish trap and dio ite form precipices near the road. Where the boss strikes tl River road, the diorite contains scales of specular iron ore; b there appears to be no alteration of the Silurian rocks.

Blanchard.

Iron ore.

In the west branch of Blanchard Brook* there are outcrops greenish massive diorite and reddish breccia in contact wi which the Silurian appears more altered than usual; the foss iferous iron ore at William Ross's also appears to be cut by tl traps and diorites; as well as the Silurian rocks of the iron mi further north.

Sam Cameron's Brook.

The igneous rocks of Sam Cameron's Brook are of great varie and interest; they underlie the black slates of the Clinton and tl siliceous sandstone of the Medina, and are probably contemporaneo with the Cambro-Silurian. The lowest in the brook are greeni and purplish amygdaloids, with cream-coloured compact rocks succeeded by claystone and syenite, by a dyke-like mass of volcan breccia, and by quartzite and light-coloured agglomerate. High up, purplish and bluish-grey ash-rocks and greenish chloritic roc are associated with soapy slates, perhaps sedimentary, and with fi crystalline diorite. Light grey, greenish and cream-coloured, felsit splintery slates, of silky lustre, are intimately mixed with a apparently pass into greenish, fine agglomerate slates, and are c by dykes of dark crystalline diorite. Some of these beds are ve coarse, apparently horizontal, and associated with patches agglomerate resembling that of Bear's Brook. Greenish, cream-coloured and reddish, felsitic, soft aluminous shales, containing greenish, soft, steatitic patches, are cut by an irregular vein a foot thick but thinning out, composed of limonite and spathic iron. There are also light-coloured, compact, ribbanded rocks, the banding of which is vertically 167°, and resembles the colour lines of a slag, but which split more readily along the nearly horizontal lines above described. Scales of specular iron ore are in the joints; and chloritic diorite, breccia and massive felsite are found higher up. Greenish, massive diorite and syenite are found in McLellan's Brook and on the neighbouring hills not far above the contact of the Carboniferous.

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*Trans. N. S. Inst. Sc., vol. III., p. 63.

Iron ore.

McGregor's Mountain.

The Weaver's or McGregor's Mountain is composed partly of black vesicular trap of doubtful age, with conglomerate in contact with Carboniferous rocks.

East River.

Specular iron ore.

2. *Devonian Igneous Rocks.*—The igneous rocks of John McDonald's (Ogg) Brook (page 35), not far above the East River of Pictou, consist of reddish and greenish massive felsite, trap, syenite and diorite, granular and compact, of serpentinous diorite-breccia and coarse, rusty calcareous agglomerate, with other varieties like argillite or amygdaloid. In the fields near the little branch from John McDonald's (Weaver) are chloritic and quartzose gneiss, felsite and diorite.*

Reddish trap cuts dark grey massive argillite near the contact of the Carboniferous and Devonian rocks of Archibald's Brook; while higher up is a massive, grey, calcareous, porphyritic felsite, in part vesicular, in part yellowish-white, decomposed and trachytic, containing spots of specular iron; and at Archibald's bridge, a granular syenitic rock. Blocks of a reddish trap are also found near Alex. McDonald's, at the head of Black Brook, and of coarse diorite at Centredale; while at Sam Cameron's mill is an outcrop of grey, greenish and reddish, massive or laminated and wrinkled felsite-breccia.

West Branch, East River.

In the west branch above Elgin, Upper Devonian rocks are associated with greenish and cream-coloured flinty rock, agglomerate and purple loosely coherent breccia.

Marshdale.

About Lorne are many large blocks of greenish-grey, white-veined, gneissic diorite, the veins being of compact or granular felsite. Near Cameron's Brook, opposite Jessie Grant's, a hill shows compact and granular flinty quartz-felsite. Near the Marshdale school the trap and diorite, well exposed on the hill, contain traces of specular iron ore and have been prospected in several pits Except on the hill, however, sedimentary rocks are probably i place. The diorite near the limestone is a soft mixture of feldspa hornblende and chlorite; it is well seen on the Crockett road, an perhaps cuts Carboniferous rocks. Large blocks of chloritic, whit veined, hornblendic rock are found south of Kenneth McKenzie' at Lorne; also a doubtful outcrop of rusty-weathering, ligh greenish-grey, calcareous clay-rock, sometimes shaly, resembling crystalline limestone and full of blotches of pink calcspar.

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*Trans. N. S. Inst. Sc., vol. V., p. 206.

Glengarry.

On the Cross Brook are light grey, slaty, felsitic, epidoti obscurely fragmental rocks with threads of ankerite and specula iron ore; and in the Big Brook, above John McDonald's road, larg blocks of dark, pyritous, finely crystalline diorite with white vein Near Glengarry, on the road to Concord Mills, calcareous flint trap cuts reddish coherent Devonian argillite; west on the railwa are blocks of trappean and fragmental rock; and near the thirtiet mile-post, a pit south of the railway exposed decomposed, felsiti and granular, flinty hornblende-rock. On the road from Glengarr to Lorne by John McDonald's, granitoid, syenitic and felsitic debri appears near the school; and between McDonald's and the roa near Cross Brook the land is bouldery with diorite derived fro the hills of the vicinity. The blocks of veined diorite near th railway tank are followed on the road westward towards Lansdowne by others of purple trap. The reddish and dark trap o Robert Gordon's Hill, north of Glengarry, occurs between layers o limestone at the quarry, and also cuts a bluish-grey slat siliceous rock; near the main road on this hill are reddis porphyritic felsite and trap.

The sandstones in the neighbourhood of the diorite of the Marshdale Hills are slightly indurated, and the greenish and reddis argillites in some places almost porcellanous, but not more so tha the strata of Millbrook. The hill between the Crockett road an Jessie Grant's is apparently in great part trappean. At the picni ground at the north end of the hill, compact and fragmental felsit is intimately mixed with reddish quartz-veined quartzite an greenish porcellanous argillite, knobs of rock coming through th soil on the highest peaks.

West River.

In the brook near Limerock, are cliffs of light grey, calcareous fine and coarse, rusty-weathering, trachytic and fragmental rock full of grains of chlorite.

On the opposite side of West River, near the head of Six Mil Brook, compact, greenish, felsitic, serpentinous, dioritic rocks ar covered on both sides by Permian, at what may be termed the east end of the Cobequid Hills. The arrangement of the rocks in these hills is stated thus by Sir J. W. Dawson*: "There is a central mass of red intrusive syenite or syenitic granite, usually having a large predominance of red orthoclase, with a moderate quantity of hornblende and quartz. This sends veins into the overlying beds, and is itself penetrated by dykes of diabase. On this central mass rests a great thickness of felsites, porphyries, felsitic agglomerates and diorites, evidently of volcanic origin. Upon these are grey, black and reddish slates and quartzites, with a bed of limestone, and penetrated by metallic veins........... The rocks have been altered and elevated before the Carboniferous period†; but, on the other hand, these altered rocks themselves are in part Devonian, and there is no reason to believe any of them to be older than Upper Silurian."

Structure of the Cobequid Hills.

Underlying the Permian conglomerate of Mount Thom is a reddish and grey coarse syenite and greenish and grey gneissic rock; at the west end of Mount Thom, greenish diorite, greenish, reddish and grey granular and porphyritic felsite, quartz-felsite and syenite; while near the Telegraph road, dark green, soft, fine diorite is in contact with greenish-grey slates. Near Bezanson's, a pit fifteen feet deep has been sunk in search of gold, in a grey crystalline diorite, associated with rocks similar to the above; and further north, greenish felsitic rock is veined with calcspar. At Mount Dalhousie, grey and greenish, massive, felsitic rocks include greenish and purple and dark breccia, calcareous, felsitic, chloritic, somewhat pearly, often slaty, like the rocks of Coxheath. On the hill south of Loganville and in the Biorachin are outcrops of grey and black syenitic rock and of all the other varieties of Mount Thom. In some of the little tributaries of the west branch of River John, above Loganville, there is a great variety of these rocks. In one of them from the west they comprise amygdaloid, fine trap, epidotic and compact felsite and breccia, with apparently a southerly dip like the associated fine sediments. Up stream are reddish and grey syenite, greenish grey, nearly compact Coxheath felsite or diorite, with a well-defined bedding or cleavage, which dips 177° < 40°.

Mount Thom

Search for gold.

Loganville

On the road to McIntosh Lake, and in the brook near the lake, reddish and grey coarse syenite is abundant. Further down stream, greenish diorite is succeeded by greenish-grey, pearly, pyritous felsitic slates, often papery and scaly, showing flakes of different

McIntosh Lake.

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*Acadian Geol., Suppl., 1878, p. 79.

†Acadian Geol., pp. 561 and 580.

colours, spotted with quartz, serpentinous and chloritic, with calcspar in the joints, and with veins, sometimes three inches thick, of white barren quartz; and where overlaid by the Permian conglomerate, associated with grey massive felsite, quartz-felsite and diorite.

Salmon River.

Dykes of black and light green crystalline hornblende-rock or diorite and of massive greenish-grey or grey felsite cut the Devonian strata of Salmon River, above the fork of Black River, the sedimentary strata being considerably altered near the contact, and having specular iron ore developed from the ankerite veins so abundant in the neighbourhood, as is often the case in proximity to the dykes. The bright red slates at the uppermost and largest of the dykes, resemble those near the manganese mines. No other igneous rocks appear in the river as far as the head of the settlement.

Specular iron ore.

About 100 paces south of the railway station at Riversdale, large blocks of reddish-grey syenite may indicate a boss of this rock, but are perhaps drift. The outcrop of grey, soft, vesicular, calcareous trap about a mile below the driving dam on Calvary Stream has already been referred to. North of Steele's Run, the hills show grey and greenish diorite, syenite and felsite, sometimes slaty and chloritic. On the main road through Upper Kemptown, and on some of the by-roads, are large exposures of red syenite, mixed with blackish diorite, succeeded towards Earltown by fossiliferous rock, mixed with grey amygdaloid. Some of the syenite is coarse; much of it is of a fine colour and probably fit for ornamental purposes.

Ornamental stone.

Diorite and syenite are in contact with Devonian and newer rocks in the Juniper Meadow Brook and other streams of the vicinity, being separated from the latter by faults.

Valley.

On the Telegraph road, about a mile east of Valley cross-roads, is a hill of coarse black diorite, not extending far above or below the road; associated with flesh-red compact felsite, overlaid by Triassic rocks.

North River

Many rocks of this group in North River have been incidentally described with the Devonian, with which they are in contact. The outcrops of syenite, diorite and trap of McKenzie settlement, of Brian Lynch's, and of the road towards Earltown, are shown on the map. On the Tatamagouche road, in the neighbourhood of the old mountain inn above McCallum settlement, red syenite is abundant in the brooks and extends to the head of Falling Brook, a stream which runs from a large barren or peat bog, winds for some distance without showing rocks, then rushes over nearly compact syenite rock and plunges into North River, over a cliff, forty feet high, of reddish coarse syenite, succeeded in the river by Devonian sediments, cut by dykes of syenite and diorite.

On the west branch of North River about a quarter of a mile above the saw-mill at McCallum settlement, a bluish-grey calc-veined limestone is seen, dipping first at a low angle, then overturned and ending in contact with a dark greenish-grey crumbly diorite or trap, like that of New Annan, into which it penetrates in wedge-shaped masses, the bedding conforming in places with the line of contact, and small detached pieces of the limestone occurring in cracks in the diorite to a distance of twenty feet from the contact. The greenish, massive, rubbly Devonian rocks which immediately succeed are more flinty and altered than usual: they include ferruginous calcareous bands, light grey flinty sandstone and a grey rusty-weathering quartzite, showing plants converted into anthracite, resembling a Guysboro' quartzite, and succeeded immediately by greenish, fine fragmental, igneous rock. Greenish, quartzose, greatly altered sediments are again seen, including a reddish argillite, full of spots and veins of specular iron ore, cut by a dyke of red igneous rock resembling mud squeezed into them; succeeded by greenish-grey trap and diorite, mixed with small patches of red syenite, which increase until the whole brook is occupied with bright red syenite. Then for more than a mile up stream, the magnificent gorges of the river show mixtures and alternations of dark diorite and reddish or light-coloured syenite; above which near a saw-mill, is a breadth of more than half a mile of sedimentary rocks. Succeeding these, as far as the road crossing, is another belt of light greenish trap, granular, fragmental and porphyritic quartz-felsite and greenish diorite, sometimes exhibiting rough bedding and containing patches of bright red syenite.

Fossil plants.

Earltown.

The dykes near the head of Nabiscump Brook consist for the most part of greenish fine diorite and reddish quartz-felsite. The rocks which cut the Silurian in the little brook immediately above Earltown are of considerable variety, including a purplish-grey, fragmental, scaly rock, greenish and dark diorite and syenite, overlaid by Permian conglomerate. Below Earltown falls (which are "fifty feet high, resembling the falls of Foyers in Scotland,") are cliffs of greenish-grey, blackish and dark-reddish diorite and trap, full of veins of calcspar and quartz. The rocks of the falls consist of diorite and trap; but at the base are traces of red soft argillite, probably included masses of the supposed Devonian rocks of the brook to the eastward of the road.

On some of the roads about the head of Matheson Brook, are outcrops of slaty or schistose felsite, full of quartz, and of dark trap. Nearer North Earltown, reddish, fine, granular quartz-felsite is mixed with argillite, and with greenish and light grey, striped, compact porphyry, containing grains of quartz. In one of the branches is a cliff of dark reddish and greenish, flinty and soft, calcareous, compact and fine trap, with felsitic, chloritic and dioritic slate, containing veins of quartz upon which a shaft has been sunk in search of gold. Underlying the Permian conglomerate of Moore's Brook, are greenish, slaty, felsitic, soft and rubbly, calcareous rocks, which extend west into Waugh River.

Search for gold.

On the road from Nuttby to Waugh River, the coarse syenite and porphyry of the south side of the mountain are succeeded by the traps of the north side. Where these come from beneath the conglomerate above the falls in Waugh River they consist of light grey and greenish-grey agglomerate and of bottle-green felsitic or dioritic breccia, like that of James River, containing much chlorite and a few blotches of quartz and syenite, and showing in places a minute jointing or lamination. Higher up, similar rocks, containing more quartz, show a kind of scaly foliation which dips 118° < 30°, and include flinty diorite and imperfectly crystalline syenite. In one of the tributaries from the west, reddish, fine, coherent sandstone is associated with grey soft trap and greenish flinty diorite.

Falls of Waugh River.

Foliation.

Dark-greenish and blackish trap and diorite, fine and crystalline, with blotches of calcspar, occupy most of McDonald's Brook, and in the clearing near McDonald's house are in contact with red sandstone at a little fall, whence they appear at several points on the road towards the Earltown road. Ferguson Brook, one of the wildest streams of this part of the country, shows cliffs of dark grey and greenish, compact and crystalline trap and diorite cleft in one place into a small cave. In the adjoining tributary of Waugh River from the south, reddish, fine, massive sandstone or quartzite is cut by dark grey, fine, crystalline trap or diorite; and higher up the brook, red argillite is associated with red flinty quartz-felsite and amygdaloid. Other outcrops in this neighbourhood show igneous rocks cutting red sediments which consist of conglomerate, quartzite and argillite.

Cave.

Among the Silurian rocks of Spiedel Hill are grey, greenish and rusty-weathering, compact, porphyritic felsite, with crystals of amber-red feldspar and small spots of colourless vitreous quartz, passing into granular felsite and quartz-felsite. In the little brooks above Gilbert Sutherland's, schistose rocks are exposed, Murray's Brook showing felsites from the road to the river.

Immediately west of Waugh River on McLeod's farm is a dark rotten trap; but for some distance before reaching Mr. Paul McDonald's house, the debris indicates flinty porphyritic felsites, like those of Coxheath, which extend to Little River (Sutherland Stream) at the mill-dam and are well exposed down stream to Bailey's bridge and up stream to Kavanagh's mills. The first rock seen below the mills is light grey fine trap and blackish and red amygdaloid with a tendency to globular structure; succeeded by reddish and greenish, massive, flinty felsite, obscurely porphyritic, sometimes in layers dipping 51° < 40°; greenish-grey and red chloritic and calcareous, fine, softer diorite; compact felsite and porphyritic diorite, with veins of colourless oily quartz, four inches thick, which have been mined; flinty fragmental felsites; and bright flesh-red compact quartz-felsite. About a mile above Bailey's bridge, a greenish, striped, jointed rock, very like a quartzo-felspathic sandstone, probably sedimentary, is immediately followed by the felsites. At Drysdale falls, greenish chloritic and dioritic rocks, soft, slaty and crumbly, are cut into a pillar separated from the mass in the bank. Below the bridge, as already mentioned, these rocks are succeeded by reddish, flaggy, Permian sandstone. Above Kavanagh's mills the brook shows, as far as the little lake at its head, a few outcrops of greenish-grey and blackish trap, with small white amygdaloidal spots, associated, on the Corktown road, with masses of dark green nearly compact diorite. In the east branch of Little River, not far above the fork below Kavanagh's mills, blackish, greenish and reddish, compact and crystalline, soft, calcareous trap, easily broken up to make the fertile soil of this part of the mountains, is well exposed. A short distance higher, bluish-grey and geenish-grey argillites, in flaggy layers, dip 257° < 45° They yielded no fossils, but lithologically are like Silurian. They are underlaid by cream-coloured claystone of igneous aspect, succeeded by massive trap in cliffs. At the head of this branch, grey and blackish amygdaloid and diorite are succeeded by reddish nearly compact quartz-felsite or syenite and light grey rusty-weathering compact felsite, with a few porphyritic crystals.

Bailey's Bridge.

Quartz veins.

Silurian strata.

A brook crosses the road west from Bailey's bridge, 495 paces east of the cross-roads, and shows up stream outcrops of light and dark bluish-grey rubbly rock, probably an altered felspathic sandstone, dipping apparently 207° < 25°; succeeded for a short distance by cliffs of greenish diorite; these in turn, by quartzites and porcellanous argillites.

Dark trap and diorite are seen also to the westward as far as the Tatamagouche road. On the Four Mile brook, the first rocks south

Four Mile Brook

of the Permian are grey, reddish and greenish, flinty, splintery and rubbly felsites, some of which are fragmental, full of quartz veins; greenish compact porphyry; greenish and purple, mottled, soapy, soft, aluminous slates, like those of Louisburg and Coxheath,* scaly and serpentinous containing spots of hematite and a large quantity of calcite. Greenish felsite-slates are found on the roads between this point and the French River.

New Annan.

Schists.

In French River† immediately above New Annan bridge, grey and greenish, rubbly, porphyritic slates and flinty, pearly, papery or scaly slates dip 77° < 49° with regular bedding or foliation. A little higher, greenish, much less regular, felsitic slates, containing a vein of white crystalline calcspar, three-quarters of an inch thick, are associated with greenish, light grey and black chloritic schists, in which the veins and blotches of calcspar are sometimes three inches thick: they are greatly corrugated, banded and striped, scaly, pearly and silvery, sometimes nearly horizontal, and hold large masses of quartz. High up the river at a dam, the schists are replaced by black, rusty and crumbly diorite and trap, among which occurs a greenish-grey fine limestone which has been burnt, the relations of which to the igneous rocks, however, require further examination.

Limestone.

Near the head of Byers Brook are outcrops of red flinty quartz-felsite, with grains of quartz, and of dark grey felsites and diorites, magnetic and containing small porphyritic crystals of feldspar and pyrite; and further down, vesicular and amygdaloidal trap. In the fields near William Warwick's, among other varieties of fragmental and Coxheath felsite and quartz-felsite, is a light-coloured slaty variety that might make a good fireclay, but does not seem to be abundant. At a school on the road to the Florida road, dark friable trap and diorite abound.

Fireclay.

Old Tatamagouche road.

For some distance south of its junction with the present road near the head of the west branch of North River, the old Tatamagouche road shows rusty-weathering compact felsite; succeeded, at 880 yards from the fork, by dark green diorite, veined with epidote, and bright green and red, mottled, compact and fragmental felsite; and at 1,475 yards, by cliffs of massive porcellanite or altered argillite; while in a brook at 2,850 yards, dark and light grey Devonian shale and quartzite extend nearly to the North River, where the slates are mixed with great masses of dark diorite and small patches of red syenite, above a narrow mill-pond at the head of a gorge. Further south on the old road are other outcrops of diorite.

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*Geol. Surv. of Can., Rept. of Progr., 1875-76, p. 379; 1876-77, pp. 419 and 425; and 1877-78, p. 8 F.

†Geol. Surv. of Can., An. Rept., 1885, vol. I., p. 60 E.

Chiganois River.

Gneiss.

Devonian slates.

On Chiganois River, the first igneous rock seen above Higgins' mill is a dark reddish somewhat compact trap, succeeded up stream by a small outcrop of sedimentary rock; then by reddish coarse syenite which surrounds a patch of red argillite. Grey and reddish syenite and greenish epidotic diorite then form falls, probably thirty feet high, in a rocky, inaccessible gorge; from the head of which the syenite, though including patches of almost pure quartzite, alternates with diorite in unbroken cliffs for a great distance. In places the syenite is bright red; the diorite is greenish, shows gneissic lines; and up stream, grey gneissic rocks underlie massive syenite. At the fork of the river, whitish-grey layered rocks dip 345° < 80°, the bands being of fine gneiss, of quartz and of felsite. The bands of contorted gneiss which occur among the massive rocks resemble those of St. Ann's, Boisdale and Margaree, the dip is regular but contorted and the lamination very fine. Then come dark hornblendic rocks, also gneissic, with massive grey diorite; followed by alternations of coarse syenite and diorite immediately in contact with slates of the iron ore series, which occupy a breadth of more than a mile below Patterson's old mill, above which, syenitic rocks are again seen. At the mill and on the road from it, reddish porphyritic felsite and quartz-felsite abound, whereas on the Tatamagouche road at the end of this road, grey trap is in place. The few rocks seen about Clear Lake are syenitic; but on the road from that lake to Peter McIntosh's at the head of New Annan settlement, flinty felsitic or dioritic rock gives place to dark bluish-grey trap and diorite, found also on the track across the hills to Nelson's Corner and towards Kavanagh's mills. The little brooks immediately west of Chiganois River above the Higgins road also show outcrops of igneous rock among the Devonian. In that nearest the river, these consist of dark grey calcareous and chlorite volcanic ash or mud rocks, and of light grey and purple mottled amygdaloid; and in the second, of blackish diorite, whitish granular diorite and flinty breccia. In the upper part of the main branch of Old Sam's Brook, reddish coarse syenite and dark grey diorite contain calcite, epidote and chlorite, the syenite passing into granular quartzfelsite. The associated sedimentary rocks are reddish slaty flinty sandstone or quartzite and porcellanized red argillite.

In Higgins Brook nearly all the outcrops above the conglomerate consist of syenite, diorite and trap.

Debert River.

The igneous and sedimentary rocks mixed in the Debert River, three-quarters of a mile above the bridge at Cottam settlement, have been already described: the first seen are traps and diorites, succeeded by whitish coarse diorite containing much quartz, coarse grey syenite with obscure gneissic patches, whitish massive quartz which may be sedimentary, and is usually in contact with or near dark slates altered into schists. Similar alternations extend nearly to McMullin's mill* from which a long logging-sluice runs down the river to Debert station. Near the mill, red syenite is associated with greenish breccia, in contact with greenish, flinty, slaty or porcellanous rocks which show black marks resembling plants, and mixed with silky slates and reddish porcellanite, including a thin band of crystalline limestone. At the mill, greenish epidotic, flinty, felsitic rocks, reddish or purple dioritic slates, often epidotic and chloritic, and reddish and greenish pearly slates have an easterly strike. Above the mill-pond, greenish chloritic schists include a band of what appears to be altered sedimentary rock, bedded conformably with them, and extend to the mouth of Shatter Brook. At the bridge on this brook are greenish, scaly, chloritic, soft rocks; below it, they are succeeded by red syenite cut by a dyke of black diorite, two feet wide, below which pyritous diorite and syenite are mixed to the river. Above the mouth of Shatter Brook, grey and greenish chloritic slates give place to banded and contorted syenitic rock, succeeded by massive syenite and diorite. The banks are then low and the outcrops less imposing, but ledges of red syenite with patches or dykes of dark diorite extend to Debert Lake, the syenite being in places coarse and containing very little hornblende.

Limestone.

Totten's Brook.

On the south side of the marsh at the iron mine on Totten's Brook are small outcrops of mottled, massive, fragmental, granular syenitic and felsitic rocks, stained with films of red hematite and carbonate of copper, and light greenish diorite, blotched with specular iron ore, in contact with very flinty flags or porcellanites. Near the head of the brook is a greenish, soft, granular diorite. In the east branch of this brook, north of the sedimentary rocks, a dark green diorite, sometimes soft and containing traces of specular iron ore, is followed by coarse syenite with patches of green soft diorite.

Pine Brook.

In Pine Brook* not far above the Totten settlement, greenish compact and granular diorite, containing films of red hematite and blotches of white calcspar, in which are dendritic markings of specular iron ore, are associated in the cliffs with mottled greenish and reddish, fine, fragmental breccia; above which appear other rocks of the iron ore series in contact with greenish soft pea-breccia, containing globular masses of dioritic rock; alternating with dioritic schist, flinty gneissic quartz-felsite, breccias with patches of sedimentary rocks, hornblende schist, striped quartzite, granular quartz-felsite and other gneissic rocks with a steep southerly dip. Near the head of the brook are coarse and fine syenite and diorite and whitish compact quartz-felsite.

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*Geol. Surv. of Can., An. Rept., 1885, vol. I., p. 56 E.

Intercolonial railway.

The dykes of diabase and syenite,* which cut the Silurian rocks west of Wentworth station, have been already referred to. Between Wentworth and Folly, reddish, flinty, obscurely granular quartz-felsite and syenite are associated with diorite and porphyritic felsite, as described by Dr. Ells.† Below the outlet of Folly Lake, diorite and syenite are seen in several cuttings along the railway and in the river, succeeded by sedimentary rocks at the first snowshed near the siding, the latter being cut across and in the bedding by dark flinty diorite and reddish compact quartz-felsite, and intermixed with massive igneous rock and with chloritic and mica-schist veins of quartz, sometimes of large size being found in connection with some of the patches and prospected in the hope of obtaining gold. These rocks are well seen near the fork of the river, and are very interesting.

Search for gold.

Above the railway, the iron ore rocks of McElman Brook are cut by greenish, fine diorite, succeeded by light-coloured compact and granular quartz-felsites, flaggy and like gneiss in part, and by greenish-grey massive diorite or hornblende-rock. Blackish very fine diorite cuts the sedimentary rocks in several places up to the head of the brook. On the track from the east branch of this brook past Archie Slack's house to Folly Lake, masses of slaty diorite, chloritic and hornblende schists, greenish and whitish coarse and fine diorite are found with altered sediments.

Londonderry mines.

The syenite, diorite, felsite and allied rocks of the various branches of Great Village River have been already referred to. On the west branch, immediately above the bridge on the Cumberland road, black and grey diorite and felsite are in contact with light greenish and grey flinty slates, probably cut and altered by the former, while down stream the reddish and green slate and massive greenish and grey argillite and quartzite include the great vein of ankerite.

Economy River.

The rocks of this group in Portapique, Bass and Economy Rivers have been described in connection with the Devonian.

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*Acadian Geol., Suppl., 1878, p. 75.

†Geol. Surv. of Can., An. Rept., 1885, vol. I., p. 57 E.

In Murphy Brook, as already stated, after crossing a great breadth of igneous rocks, purple and greenish altered slates, with quartz-veins, blotches of specular iron ore and hard small concretions, are the finest exposures of the black Devonian shales or slates with associated Guysboro' quartzite, full of matted plants. In a branch of this brook from the westward, one of the veins of quartz in a quartzite, conglomerate and slate, is more than a foot wide, but barren.

Quartz veins.

On the shores of British Lake are outcrops of greenish, massive, nearly compact diorite; and cliffs of greenish and reddish mottled, compact trap or diorite are found on a tributary of the Bass River to the northward. Lower down this river and in the neighbourhood of the Gundalow road, greenish felsite, syenite, diorite and trap are mixed with flinty slates.

Five Islands.

For a short distance above the bridge on the shore road, the North River of Five Islands displays fine outcrops of nearly horizontal Triassic shales. These are underlaid at a saw-mill by reddish, grey and greenish, coherent, fine sandstone and shale; and above them, with a high north-easterly dip, appear light grey, fine, flinty sandstones, with layers of dark shale full of *Naiadites*, and of carbonaceous matter, very like rocks of the North River of Onslow and precisely like the altered rocks of Portapique River. Higher up, the dip changes to 165° < 37°, then to 332° < 33°, and again to 155° < 22°, and dark crumbly argillites, breaking into long knife-shaped pieces, are full of fossil plants, show an inch band of coaly shale and are overlaid by greenish compact sandstone or quartzite, containing ferruginous matter and associated with a greenish shale, like that of the mill-dam, full of *Cordaites*, ferns and other fossil plants and penetrated by minute veins of limonite. Near the seventy-two feet fall occur greenish-grey massive, flinty sandstone or quartzite, nearly vertical, resembling certain iron ore rocks of Great Village River; cream-coloured massive quartzites, with veins of siderite and ankerite; cream-coloured and olivaceous soft shales, with a coaly band, three feet thick, and a large vein of iron ore on top dark and light grey flinty quartzites and slates in contact with a massive diorite, containing calcspar and hematite. At the top of the fall are greenish and dark slates and quartzites, probably the altered equivalents of the rocks near the mill pond, with greenish diorite-schist, whitish, compact crystalline limestone or marble spotted with grey, greenish and yellowish, white-weathering fibrous serpentine, perhaps in a vein, and grey massive diorite. Above the outcrop of marble are others of dark and light-coloured shales or slates, sandstones or quartzites, up to a little brook from

Sedimentary rocks.

Igneous rocks.

Marble and serpentine.

the westward, above which wrinkled slates are intersected by small dykes of diorite and syenite; while still higher these rocks totally replace the slates.

Lynn.

Up the little brook mentioned above, red syenite prevails. From its head, blocks of syenite, diorite and altered slate are found to the the back road at Lynn.

Harrington River.

In the first large branch of Harrington River from the westward above the Parrsboro' road, coarse syenite and diorite are associated with grey flinty quartzites and red or purple porcellanite, dipping, 288° < 50°. Higher up are blackish diorite or breccia, full of grains of specular iron ore, and cream-coloured, soft, pyritous, brecciated vein-rock, among greenish slates and chlorite-green, wrinkled diorite-schist, with small veins of mixed quartz and calcite, which extend for some distance and are then succeeded by more massive red syenite, reddish and brown granular quartz-felsite and felsite, often porphyritic and epidotic. In a small branch of this brook from the north-east, bright indian-red altered argillite is associated with reddish and greenish trappean rock. Above the fork, reddish epidotic felsite and amygdaloid extend to the wet, mossy lands at the head. In an adjoining brook to the westward, at the Parrsboro' road, grey, flinty, Devonian flags, and black slates, dip 34° < 50°; and above the road contain plants. Where the brook comes over a fall thirty feet high, grey, coarse syenite is exposed; above the fall, greenish-grey schists dip about 177° < 45°, near a mass of red syenite; then light greenish-grey and grey quartzite-flags and dark slates, precisely like the sandstones and shales down stream, but more altered, are cut by ferruginous veins an inch thick, and succeeded by purple porcellanized argillite, light grey soft argillite, greenish, cream-coloured and grey calcareous breccia, replaced in turn by syenite and diorite with small patches of grey slate.

Mixed sedimentary and igneous rocks.

Moose Creek.

At the head of a branch of Moose Creek, immediately to the westward, red syenite, porphyritic felsite and quartz-felsite are well exposed to the bottom of the hill, where light grey, flaggy, flinty sandstone and dark shale, not much altered and containing *Naiadites*, dip 202° < 46°, being, perhaps, separated from the syenite by a fault. Immediately below the contact, a little brook from the left shows grey, coherent flags, dipping 74° < 17°, while at the post-road dark shales and flags dip 134° < 5°, but, a short distance to the eastward, strike in vertical beds 127°. In the branch from the left, a considerable thickness of grey, rubbly sandstone or quartzite and shale dip 155° < 17°. In a little tributary from the north, they show markings of *Calamites*, seem to pass

Fossils.

into flinty, quartz-veined porcellanite and quartzite, and are spotted with specular iron ore; and on the hill these latter give place to red syenite. At the head of the very steep and rocky little branch of Moose Creek, west of those mentioned above, red syenite is well exposed. Down stream it includes a mass, five feet wide, of dark green, fine diorite, immediately succeeded by or mixed with, greenish, compact, soft and hard argillite or rubbly porcellanite; light grey and greenish argillite and quartzite, veined and twisted, dipping 167° < 80°, the veins being mostly of reddish compact and fine grained syenite and felsite; nine feet of massive syenite with a patch of veined, bedded rock; dark red and greenish, nearly compact, fragmental felsite; followed by dark grey Devonian argillite, breaking into cubical blocks, interstratified with greenish-grey sandstone or quartzite, like that of Loch Lomond, with yellow ochre in the joints, dark grey argillite and light grey sandstone, with obscure fragments of plants. About twenty-five yards lower, a band of blackish shale, only partially exposed, has an altered aspect, breaking out in rectangular blocks or in pieces with a woody-fibre cleavage, difficult to split in the bedding, but showing on some layers *Naiadites* and a long, grass-like plant; it dips 157° < 32°, and is succeeded down stream by sandy micaceous flags and dark shales, with *Naiadites*.

Contact with sedimentary strata.

West Branch of Harrington River.

The falls of the west branch of Harrington River at the fork show red felsite and quartz-felsite, massive, compact or finely crystalline. Above a fifty-foot fall, about a mile from the fork, felsite and syenite are in contact with greenish and light grey slate and quartzite, probably greatly altered sediments, succeeded by greenish and dark grey massive argillite, dipping 142° < 36°, and containing minute veins of quartz; these rocks, after occupying the brook for more than half a mile, become mixed with dark and light green and grey diorite and felsite and red syenite, at the upper end of which, coarse, grey, soft, calcareous, dioritic rock, in contact with light grey, altered, flinty argillite, is succeeded by light greenish schistose rock, perhaps, also, altered argillite, and by greenish slates, porcellanites and schists, the whole occupying a breadth of 340 yards, beyond which the brook comes through alders and mossy land in a spruce thicket, in which no rocks are seen for a distance of 1,430 paces to a small rapid about three miles from the fork, at which a compact rock, perhaps an altered argillite, is associated with greenish epidotic diorite. In the level, wet land between the head of this brook and a portable mill near the head of a tributary of Harrington River no rocks were seen; between this mill and the north end of the settlement of Lynn at

Lynn.

Peter A. Lewis's house, are several outcrops of red coarse syenite and greenish diorite; but, immediately north of the house, and also in the fields south-west of George McLennan's, are grey and greenish altered slates. Below Lynn, Harrington River shows in its gorge similar intermixtures of greenish massive and schistose diorite, red syenite and greenish flinty slates, the diorite-schists having, for a great distance, in common with the other laminated rocks, a low dip to the eastward, containing chlorite, epidote, minute veins of quartz, in some places asbestiform fibres, several inches in length. Similar alternations are seen on the road to Five Islands.

Asbestos.

Devonian strata.

The junction of the two series is also well exposed in several of the branches of Boyd Brook. Between the river and the lower bridge on the Lynn road, dark shales and flags and grey sandstone or quartzite dip very regularly $154^\circ < 45^\circ$; while at the old mill-dam above the road, purple and greenish, mottled, flinty, rubbly rocks, like those of Brian Daly's Brook, have a nearly vertical southerly dip and are underlaid by the light grey and greenish-grey, rusty-weathering, compact, massive and rubbly quartzites of the iron ore series. Higher up the brook, dark slates and flags display obscure carbonized plants; one portion looks like an underclay and has a lenticular patch of coarse grey grit. The lenticular, pyritous and siliceous plates or veins of the rusty rocks may represent the ironstone of the less altered strata; the dip is greatly contorted and scales of specular iron ore are abundant. At two points the rusty-weathering rocks, greatly veined with ankerite and spathic iron, are mixed with what seems to be a fine agglomerate, breccia or claystone, soapy and soft; the second outcrop being thirty yards below a little brook from the eastward. For about 180 paces above this fork, rusty quartzite and purplish-grey argillite are exposed. Immediately north of it, on the Lynn road, grey and reddish quartzites are succeeded by felsitic, dioritic and syenitic rocks like those described above. At forty paces up the little brook from the eastward, red syenite is also exposed for fifty-six paces; then whitish, soft, soapy claystone or breccia, for seventy paces, with lumps of quartzite succeeded by light quartzo-felspathic rock, perhaps sedimentary, with a shale or slate, rich in graphite, which has been prospected by a tunnel. Then for 283 paces are alternations of blackish diorite, greatly altered, purplish, dark and light grey flinty flags, whitish or cream-coloured calcareous flags, dark, flinty, rubbly sandstone and grey soft sandstone or breccia; then 165 paces of red syenite succeeded by masses of light greenish diorite, broken up in a search for asbestos, which occurs irregularly intermixed with

Contact.

Graphite mined.

Asbestos.

quartz veins. At 155 paces beyond, the hill exposes purple rubbl sandstone or quartzite, interstratified with greenish and dark slate and other intimate associations of these different rocks have bee traced in the fields and brooks of the neighbourhood, as shown o the map.

Moose River.

Igneous rocks are in contact with the Devonian of Moose Riv about a mile above the Parrsboro' road. About 250 paces above th road, dark shales, striking 314° with a vertical dip, are interstrat fied with flinty flags; while 375 paces higher, the dip is 151°<25 and continues at this moderate angle for some distance. The san stones contain small veins of quartz; the shales, nodules of iro stone, rootlets, stems and leaves of *Cordaites;* while both are inte sected by veins and blotches of ankerite. About ninety paces belo the first appearance of the igneous rocks, greenish-grey, flagg sandstone or quartzite and dark argillaceous shale, containing sma threads of limonite, dip 162°<58°, and some of the finer beds sho good specimens of *Cordaites.* Then after a concealed interval, com greenish-grey, massive, white-weathering, felspathic and dioriti rock, passing in places into red syenite; succeeded immediately b grey, flinty, porcellanous slates, cut by veins and blotches of re syenite, a foot thick and downward, and resembling what one woul imagine the fossiliferous rocks down stream might alter into. The rocks occur at a brook from the north-east and are succeeded b cliffs of red syenite as far as a large brook from the north-wes immediately above which, greenish compact sandstone dips 162° 68°, interstratified with green slaty or schistose rock, in pa apparently dioritic, with flinty flags or compact quartzite, dark gre porcellanized argillite and light grey sandstone or quartzite, full quartz veins which contain chlorite. About 585 paces above t last little brook, the river comes over a fall into a deep pool, abo which is an inaccessible gorge. Slates extend to within 130 pac of the face of the fall and are in contact with greenish diorite ar red felsite; and from the fall up to the large driving-dam, india red, spotted, soft trap or volcanic-breccia, passing into compa flinty felsite containing aggregations of quartz and red porphyrit crystals, is associated with greenish massive diorite on the hill, t gorge being occupied by three falls, one of which is said by M Jones to be 108 feet high and the aggregate of the three more tha 200 feet. Above the driving-dam, red and purple porphyry an greenish and reddish amygdaloidal trap extend to the fork.

Falls

Most of the tributary from the north-east below the falls, i occupied by red syenite, passing into red, compact, porphyriti quartz-felsite, and dark fine diorite, which in one place has a fla bedding or lamination, and is succeeded by a patch of greenish and dark grey altered slate, with quartz veins. The brook from the north-west shows syenite and diorite at its mouth, then a considerable breadth of dark and greenish slates, dipping 207° < 40°, in part schistose, mixed with diorite as far as a very pretty twenty-five feet fall, above which bright-red, compact and granular, porphyritic quartz-felsite and felsite occupy the stream to its source.

West Branch of Moose River.

A short distance above the Parrsboro' road, on the west branch of Moose River, great cliffs of red syenite form the mouth of a gorge. Below them, on the left bank, are dirty green and dark diorite, and reddish felsite and quartz-felsite; and not more than seventy paces down stream from the last outcrop of this igneous rock begins a fine exposure of grey glistening quartzite or sandstone, like that of Loch Lomond, veined only with small threads of ankerite, and not more altered than is usual with these rocks at a distance from the syenite; rather massive, with beds of coarse grit, full of fine specimens of the coarser parts of *Lepidodendra*, *Calamites*, *Cordaites* and other plants, with twisted, carbonized and graphitized surfaces; breaking into blocks of irregular shape, and quarried in one place for rough building stone. The dip is not distinct. At the head of a little tributary, which enters from the westward immediately below these outcrops, are knobs of red syenite, upon which in one place rests a dark crystalline diorite, which shows slaty cleavage; and less than two hundred paces lower, rubbly felsitic and dioritic rocks are in contact with dark grey slaty quartzite and porcellanite, full of threads of quartz and calcspar, succeeded by very ferruginous, dark and light grey shale and sandstone or quartzite, the former full of *Naiadites*, *Cythere* and *Cordaites*, the latter showing only broken carbonized plants, resembling the country rock of the iron mines, containing numerous threads of limonite and ankerite, and dipping nearly vertically to the southward. They resemble also the porcellanites up stream, but are less altered; and where soft rocks come in contact with hard surfaces, certain planes are slickensided.

Fossil plants.

Iron ore.

Road from Moose River to Parrsboro'.

Along the Parrsboro' road to the westward, dark shales and flags dip 124° < 73°, and a little further 102° < 70°. They are followed by grey, rusty-weathering, compact, rubbly quartzites, like those of Loch Lomond, including a band of greenish-grey, wavy, flaggy sandstone, which in the next little brook dip 177° < 45°, while higher up the brook the dip is very variable. Up the brook which comes into the head of the pass on the road immediately to the westward, grey sandstone and shale prevail as far as a fall, where red felsite is in place; but above it, at another little fall, is a very light grey fine sandstone, like an altered form of that seen at the road, but too rubbly to show fossils; beyond which, blackish slaty argillite is found nearly in contact with red and grey friable syenite, penetrated by veins of white crystalline limestone or marble.

Crystalline limestone.

Westward from the head of the pass, the road runs down a brook with a high hill of syenitic and dioritic rock on the north side, while on the south are dark graphitic slates, with rusty veins and nodules of crystalline limestone, interstratified with flinty quartzite, like that of the iron ore series, shown in several of the mountain brooks at and near the contact. Where the road to Parrsboro' leaves that to Prospect, the hill is still close on the right, indicating the boundary of a mass of igneous rock which is at the bridge 107 paces east from the fork of the roads, while up stream the brook shows porphyritic felsites and diorite to its head; and these rocks occupy a great part of the country back to an old mill about a mile west of the foot of Cranberry Lake, where grey and greenish-grey, greatly altered argillite and fine sandstone, dipping 277° < 15°, lie not far from cliffs of red and grey, compact, epidotic quartz-felsite and felsite. Along the south side of the escarpment the felsitic rocks can be followed to Parrsboro' River. West of the river, however, the low land which extends along Diligence River indicates the presence of light grey and greenish-grey, flaggy, rubbly quartzite and micaceous slate, full of quartz veins and dipping obscurely south; and dark and light grey flags and slates extend up to a saw-mill, above which they are intermixed with greenish, massive, epidotic diorite, fragmental felsite and syenite.

Cranberry Lake.

Head of Diligence River.

West Branch, River John.

3. *Post-Carboniferous Igneous Rocks.*—On the west branch of River John above the village are masses of dark grey amygdaloid, passing into dark green diorite, the former prevailing, being veined with calcspar and containing amygdules of calcspar, chlorite and various white zeolites. These rocks seem scarcely to affect the red marl and other Permian sediments with which they are in contact. In Plainfield Brook, near McKay's, are small exposures of very flinty, light grey and brick red, spotted felsite and quartz-felsite, underlaid by light greenish-grey, soft, trachytic rocks; while on the roads in the vicinity diorite and trap also cut the Permian.

But the finest development of the trappean rocks of this age is found overlying, cutting through or contemporaneous with the Triassic, forming Gerrish Mountain, Indian Point, Five Islands, Two Islands, Partridge Island, Cape Sharp, Spencer's Island and other headlands and islands of the north side of Minas Basin

North side of Minas Basin.

described by Gesner,* Jackson and Alger,† Lyell,‡ Dawson,§ Ells,|| and other writers, so fully that they need not here be referred to. A detailed description of the shore between Five Islands and Cape Sharp and a section of the junction of the sedimentary rocks at Two Islands is given by Sir J. W. Dawson.**

### SCENERY, CLIMATE, TIMBER, PRODUCTIONS, ETC.

Natural history.

Meteorology.

The natural history of the district need not be "particularly described, as its flora and fauna are the same with the other portions of the province. The beaver has become extinct, though the effects of his labours may yet be seen in various places," several of the shallow lakes owing their origin to his dams. "Its meteorology exhibits little of interest as distinct from other portions of the province. Like the rest of the north coast it presents a remarkable contrast to the southern, in its almost entire freedom from fog. The mean and extreme temperatures are, however, higher there than here, owing specially to the influence of the Gulf Stream. The ice which comes down from the north in spring lingers long off our coast, cooling the air, so as to retard vegetation and impart a rawness to the east winds at that season, which is trying to the health, particularly to persons under any pulmonary weakness. The autumn, however, is much finer than on the south coast, there being much less wet weather, and the southern gales of that season being felt less severely." ††

Geography.

References to the geography have purposely been omitted wherever it was possible by the map to indicate the structure in such a way as to assist others in finding the localities examined, minuteness of detail being reserved for the description of the outcrops. For fuller information concerning these and other particulars, the authorities cited above, those given in last report,‡‡ Lyell's Travels in North America, the more recent histories of the province, and the various Transactions of the Nova Scotia Institute of Science may be referred to.

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*Geol. and Min. of N. S., pp. 229-262.

†Mem. of Amer. Acad. of Arts and Sc., vol. I., 1833, pp. 262-279.

‡Travels in North America, vol. II.

§Acadian Geol., pp. 99-108.

||Geol. Surv. of Can. An. Rept., 1885, vol. I., p. 61, E.

**Jour. Geol. Soc. of London, vol. IV., p. 50.

††Patterson's History of Pictou, p. 21; Cf. also Trans. N. S. Inst. Sc., vol. IV., pp. 429-438, and other papers.

‡‡Geol. Surv. of Can. An. Rept., 1886, vol. II., p. 107 P.

Barrens. Excepting the areas of barren ground shown on the map, most of the land is fit for cultivation. The most extensive barrens lie at the head of the east and west branches of the East River of Pictou, on the West River of St. Mary's, south of the Pictou branch of the Intercolonial railway. In the neighbourhood of Maple Lake, the barren is covered with ledges of Devonian quartzite and slate, upon which blueberry and other small bushes, clumps of second-growth spruce and birch and many bog and marsh plants are noticeable. On Calvary Brook are patches of wet, mossy spruce land, bogs and small, wet barrens. Part of the country underlaid by Triassic sandstone near Debert is a blueberry barren, the soil being sandy, although near the shore it is easily reclaimed by the addition of marsh mud.

Timber. Large quantities of deal, of ship and ton timber and of hemlock bark for tanning are still obtained from the forests, as might be inferred from the large number of driving-dams seen on the streams and rivers, the logging-roads and sluices. But the pines have nearly all disappeared, and spruce is the prevailing soft wood cut.

Scenery. In the mountains and along all the Pre-Carboniferous formations the brooks and rivers cut deeply into the rocks, and are clean and rapid, the land being broken, uneven and hard to work, the hills and valleys picturesque and beautiful. Falls. Falls of considerable beauty are found on the Moose River, on Economy River,* North, Waugh, Sutherland and other rivers. Near the contact of the felsites and Permian rocks in Four Mile Brook is a fall twenty-five feet high, at the top of which the water comes through a gorge six feet wide; but instead of falling vertically it is dashed against the rocks and spread for twenty-five yards at the base all broken into white spray. Above this fall are others in a rocky gorge through which the brook runs in barren land. In the adjoining brook, called Little River, are the Drysdale Falls, thirty-five feet high, above which rise cliffs thirty-five feet high, and a pool at the foot of which is said to be thirty feet deep. In Fall Brook is a pretty little fall eighteen feet high, from which the brook derives its name. On many of the sluggish streams of the low land there are Meadows. large hay marshes or meadows, overflowed by freshets. Dykeland. The dykes by which large tracts of land along the Bay of Fundy are preserved from its turbulent tides have often been described. Many of the old French dykes have been replaced by more modern ones, which cross the brooks at their mouths instead of turning Sand flats. up along them. The tidal sand flats of Shubenacadie River are shifting, like other masses of loose material along the Basin. The channel is narrow at low water, and the banks of the river high and rocky by turns.

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*Gesner's Geol. and Min. of N. S., p. 134; Acadian Geol., p. 557.

Caves. On a rough branch of the Millbrook, off the Florida road, is a cave said to be "capable of seating a congregation." In the limestone of Cross Brook is another cave; and at the contact with the Silurian the water of Holmes Brook runs beneath the limestone, to emerge as a strong spring at the Sluice, the original valley of the brook following a different direction. Several other beautiful little streams occur in the vicinity. Calder Lake is a famous resort for ducks and geese, which come to dig up and eat roots, and trout are also caught in it. East River. The roads on both sides of the East River are beautiful; near Bridgeville and St. Paul's they follow a fine intervale, being cut through gravel banks, bordered with wild roses and overhung by large trees.

Waugh River From a crack in the Permian conglomerate of one of the branches of Matheson Brook issues a large spring. The valleys of this brook are very beautiful. The soil of the conglomerate is as rich and fertile as that of Greenhill, Rogers' Hill, Fraser's Mountain and Mount Dalhousie, although the rock is in place so near the surface as to be scratched by the plough and has rendered the land barren in patches after long cultivation. The fertility of the conglomerate land is in striking contrast with the less productive character of the soil of the belt of grey sandstone overlying it, as shown by the farms.

Chiganois River. On the road from Patterson's mills on the Chiganois River, the land is not hilly, but syenitic rocks are frequent in its bed and in other parts of it corduroy has been built across the swamps. The land is poor, fit only to grow spruce and hemlock, an immense quantity of which has been taken from this district; and the same remarks will apply to most parts of this mountain range upon which no farms have been cleared.

Crops. Fruit and wheat do not ripen as well, it is said, on the shores of Minas Basin as on the Gulf shore at Merigomish, River John and Brulé; and at Pictou Island "crops appear to be more luxuriant than on the mainland,"* the soil being generally a sandy loam, which yields hay, grain and vegetables; but there is no fruit raised upon it, the exposure to sea air being unfavourable to its culture.

Botany. A list of plants found in the neighbourhood of Truro, including some found at Stewiacke, Brookfield, Valley, Onslow, Debert, New

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*Trans. N. S. Inst. Sc., Second series, vol. I., p. 78; and Patterson's History of Pictou, p. 281.

Annan and Tatamagouche, is given by Dr. Campbell;[a] a Synopsis of the Flora of Nova Scotia, by Professor Sommers,[b] the plants of Pictou county being for the most part given on the authority of A. H. McKay, Superintendent of Education for Nova Scotia; and Notes for a Flora of Nova Scotia, by Professor Lawson.[c] The native trees, fishes, &c., are described by Gesner.[d]

White lilies and violet flags were in bloom in the hay marshes near Centredale on 13th July, 1887, and in Cranberry Lake on 1st September; and the fragrant pretty little pink floating spikes of the water persicaria (*Polygonum amphibium*—var. *aquaticum*) in Forbes Lake on the 5th of August of the same year.

## ECONOMIC MINERALS.

In the foregoing pages reference has been frequently made to the occurrence of various useful minerals and metallic ores among the rocks described. These will now be more fully discussed.

*Coal.*—Statistics of the condition and production of the various collieries of the Pictou coalfield to 1869 are given in the elaborate report of Logan and Hartley.[e] Since that time this field has been described by Mr. John Rutherford,[f] Patterson,[g] Gilpin,[h] Dawson,[i] Poole,[j] in the annual reports of the Department of Mines for Nova Scotia and in those of the Division of Mineral Statistics and Mines o the Geological Survey[k] and in the Canadian Mining Manual, pp 91, 133 and 157.

Lorne, Big Brook, Kemptown and West River.

Mention has already been made in the course of this report o attempts to work coal in other localities, as at the Big Brook an Lorne, in graphitic shales or slates. At Kemptown on the nort side of the Telegraph road, several shafts and a boring, said to b 137 feet deep, have been sunk on a small seam of mixed coal an shale, which is from two to four feet in thickness. Fragments of goo coal were seen among the debris at the pit mouth. This is perhap the seam opened among the nearly vertical flinty rocks above th railway between West River station and Riversdale and again in the south branch of the North River below Mingo's.

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[a] Trans. N. S. Inst. Sc., vol. VI., pp. 209 and 283.

[b] Trans. N. S. Inst. Sc., vol. IV., p. 181.

[c] Trans. N. S. Inst. Sc., Second Series, vol. I., p. 84.

[d] Industrial Resources of Nova Scotia, pp. 77-151.

[e] Geol. Surv. Rept. of Progr., 1866-69; Cf. also Acadian Geol., p. 329.

[f] Trans. North of England Inst. of Min. and Mechan. Eng., May, 1870, ; Can dian Min. Manual, Ottawa, 1892, p. 1.

[g] History of Pictou, 1877, p. 398.

[h] Mines and Mineral Lands of Nova Scotia, 1880, p. 15; Trans. N. S Inst. Sc. vol. III., p. 281; vol. IV., p. 89; vol. VI., p. 42; Trans. Roy. Soc. Can.

[i] Acadian Geol., Suppl., 1878, p. 40.

[j] Trans. Amer. Inst. Mining Eng., vol. XIV., p. 403.

[k] Geol. Surv. of Can., An. Rept., 1886, vol. II., p. 18, S; 1887, p. 16; 1888, p. 17; 1889, p. 18.

North River coal.

About ten chains above the road to Delaney settlement on Coal-mine Brook, openings have been made on a coal seam, containing eighteen inches of stony coal, with two or more partings, overlaid by a great thickness of fine sandstone and underlaid by greenish shale or underclay, which also shows a few thin coaly bands. This locality is described by Gesner as worked during the winters of 1834 and 1835.* The present workings at the mine are on the top of a bank a short distance from the brook. The coal is bright and good, with cubical cleavage; but the stone partings exceed in places an inch in thickness. Higher up the stream, dark shales include streaks of bright coal; and about a quarter of a mile above the first seam is another, of at least three feet of carbonaceous shale, from which in places a foot of shaly coal can be obtained: this also has been worked to a small extent; and other coaly streaks occur in a band of rocks perhaps a mile in width. The slope, on the first seam, was 100 feet deep, and laid with wooden rails worked by a horse-gin and pulleys. A small frame house was erected for the miners, a forge and other necessary buildings, $1,500 being spent in development in 1889.†

Chiganois River.

The coal in the grey sandstone or conglomerate, near Higgins' mill on the Chiganois River, is in pockets, six inches wide, but dwindling within three feet to mere threads. That dug some miles down the river was nearly all coaly shale.‡

Debert River

At Debert River in Cottam settlement, bore holes have been put down and several shafts sunk on a coal seam or seams, concerning the thickness of which great differences of opinion have been expressed: for while Dr. Ells states that in the slope it was only twelve to fourteen inches of dirty coal, by Mr. Gilpin it is supposed to be of considerable value.§ The basin is evidently very limited and broken by faults. Immediately above the bridge a coal seam of a thickness of eighteen inches is exposed. Other deposits of no economic value further west have been already referred to, including that of Malagash.

Malagash

Caribou.

The coal of Caribou Island has also been referred to. Mr. McBean states that in one place it appeared to be four feet thick, but that this thickness was due to a little fault.

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*Geol. and Min. of N. S., p. 130; Acadian Geol., p. 275.

†Canadian Mining Manual, 1892, p. 119.

‡Geol. Survey of Can. An. Rept., 1885, vol. I., p. 46, E.

§Trans. N. S. Inst. Sc., vol. VI., p. 93.

On the road north of Poplar Hill several deep shafts have been sunk in search of coal; at one of which pieces of coal two inches thick are found among debris of greenish argillaceous shale. The land in the neighbourhood is barren, abounding in blocks of grey and reddish sandstone and shale.

Kennetcook. Coal has at various times been reported to occur at Kennetcook (page 97) and the vicinity. In the second little brook on the right bank of the river, below the bridge on the road to the Gore, a little coal was dug, consisting apparently of streaks and pipes in a grey sandstone full of carbonized plants and *Stigmaria*, limestone being in the river immediately down stream and also at several points above. In this brook and in another below, a quantity of grey soft sandstone dips 107° $<$ 10°–20°. About two miles to the southward, the whitish quartzose sandstone or pebbly grit used for the foundation of the new Presbyterian church is obtained, and beyond it come the auriferous slates of the Gore.

Selma. The coal reported to occur at Selma, is said by Mr. James Fraser, to consist only of thin bands of dark grey shale, with markings of plants, among thick layers of the grey flinty sandstone which forms the barrens of the neighbourhood.

Stewiacke. The search made for coal at the East Brook of Stewiacke, has been described on page 93. Explorations have also been made on the bank of Little River among the Carboniferous limestone.

Little Bass River. In a branch west of Little Bass River, near Robert Young's, a level has been driven on opposite sides of the brook, into a small coal seam, said to be a foot thick, although in this thickness seems to be included a large proportion of dark grey shale, containing masses of pyrite and ironstone. Up stream are other little seams, one of which is two inches thick, and resembles a vein rather than a bed, the inclosing rocks being reddish and grey fine sandstone and shales, greatly broken and underlying unconformably a coarse, reddish conglomerate which is probably Triassic.

Kirkhill. At the Kirkhill limestone quarry, about two miles and a half north-west of Parrsboro', coal has been found beneath nearly vertical, dark, flaggy limestone, associated with grey sandstone and shale, full of large plants. Mr. Tipping, of Parrsboro', states that at the bottom of a shaft seventy-five feet deep, the coal, which was only a few inches thick at the surface, had increased to two feet, and become more regular. In other bands of the limestone, traces of good coal are found, sometimes twisted and more like veins or lenticular masses, than beds of coal. Beneath the coal is a layer of light, soft, argillaceous shale or clay, containing nodules of ironstone, below which is broken sandstone. The coal is good; ignites very readily, burns with a bright flame, leaving a light porous coke which contains a quantity of white calcareous ash and of reddish ferruginous ash. The quarry lies on the north side of a little hill. The low flat land to the northward shows no rock, and between it and Parrsboro', there is said to be a great thickness of sand and gravel, one well having been sunk sixty feet without reaching bed-rock. On the west bank of Parrsboro' River below the town, other little seams of coal are reported by Mr. Scott Barlow.

Parrsboro.

Brookville.

Below Parrsboro', in two branches of a tributary of De Wolf Brook, a seam of coal which has attracted considerable attention, occurs in a conglomerate largely composed of pebbles of red Devonian sandstone and argillite, perhaps an outlier from the main body to the northward. Some of this conglomerate is red, but the greater part, greenish or dark grey; at the mine it is interstratified with layers of rusty-grey, coarse sandstone and soft argillaceous shale, holding carbonized plants, said to make good whetstones. The dip is not well defined, the rock being like a great irregular mass of drift, but is about 2° < 70° According to Mr. Barlow, who examined it in August, 1878, the section is as follows in descending order:—

| | Feet. | Inches. |
|---|---|---|
| 1. Conglomerate.............................. .... | | |
| 2. Shaly coal, top seam.......................... | 1 | 6 |
| 3. Grey argillaceous shale.......................... | 6 | 0 |
| 4. Coaly shale.................................... | 0 | 6 |

It has been opened at several points along the brook. Above the last opening is a red conglomerate with bands of soft red marl and sandstone. Below the conglomerate lie sandstone and red and purple argillites which appear in the pebbles; and up the main brook to its source, are light green soft breccias, soapy slates with small and large masses of quartz, and dark grey sandy slates, showing obscure shiny fragments, perhaps of plants, but not well exposed.

Hallowell Grant.

In this connection may be introduced an account given by Mr. Alex. McBean, of explorations made by him in 1888, in search of coal at Hallowell Grant.* Here a thickness of 150 feet of black shale, containing twenty feet of curly cannel, mentioned by Campbell, and a little coal, is underlaid by a great thickness of greenish shale, underlaid in turn by coarse sandstone and soft conglomerate. Mr. McBean supposes that there are several bands of this shale arranged in the form of a basin which underlies the limestone of Big Marsh post office, and is perhaps broken on the north side by a fault. The west end of this basin seems to be at the fork of the old Gulf road, and the east end at the fork of a large brook two miles east of the post office. It does not seem to pass more than half a mile north-west of Big Marsh road or half a mile south-east of McGillivray's road, until it is underlaid by the coarse sandstone and conglomerate. Dunlop's pits are north-east of the post office. A long tunnel is in the brook, half a mile east of the post office; it was driven 150 feet in black shale, cutting at the end a seam from which coal is said to have been taken. At a very small brook west of the long tunnel, the limestone overlies grey and reddish conglomerate. Up the west branch of this brook is the best coal seam in the district, said to be five feet thick and to dip to the westward, but to be broken off both east and west of the brook. A considerable quantity of coal was extracted from it. The dark shales are nearly all curly and polished; the masses of coal are lenticular or crushed. In most cases it is a hard bituminous variety, somewhat shaly, streaked with pyrite; but in places it resembles cannel.

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*Geol. Surv. of Can., An. Rept., 1886, vol. II., p. 113, P.

West River.

At the Twelve Mile House on the West River of Pictou, a boring was made 280 feet, in search of coal, supposed to be associated with the grey Permian sandstone and other rocks of this neighbourhood.

Blue Mountain.

The dark Silurian slates of Blue Mountain have been dug for coal, and in the same neighbourhood the irregular veins of quartz associated with steel-grey, silvery and rusty slates or schists have been tested for gold.

Bridgeville.

Near a mill on Archibald's Brook, at Bridgeville, black graphitic* Devonian slates were supposed to contain coal; while half a mile west of the mill, pits were sunk in search of iron ore. Near Hopewell, in somewhat similar rocks, on the farm of Jessie Grant, a shaft was sunk twenty-one feet in 1886, and from it was taken a quantity of black, shiny, graphitic clay-slate, supposed to indicate coal, and mixed with much calcareous and ferruginous vein-matter, and also with hard siliceous layers. Another pit lies about twenty-five yards from the first. About $500 are said to have been spent in exploring here.

Pictou Harbour.

On the right bank of Corbett Brook, not far above the railway at Sylvester, a bore-hole in search of coal is said to have struck Permian limestone at a depth of 400 feet. The small coal seams of Pictou, Rear Brook, Abercrombie Point and the vicinity are described by Mr. Poole.†

*Albertite.*—This mineral is found in small veins and blotches on the west branch of River John, above the village, in somewhat coherent conglomerate and sandstone in the bed of the river and on the left bank, the veins ranging from half an inch downward, and being mixed with calcspar and baryte. In places the films are very numerous, and there are blotches among the pebbles of the conglomerate. It is found at other localities in this vicinity but nowhere in large quantities, according to Mr. Donald Fraser, who prospected here for some days.

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*Trans. N. S. Inst. Sc., vol. II., Part IV, p. 70.

†Trans. N. S. Inst. Sc., vol. I., pp. 36-40.

*Magnetite.*—The amygdaloid of Gerrish Mountain, Cape d'Or, Cape Sharp, and other points on Minas Basin contains masses and veins of magnetic iron ore, one foot wide and under, "exceedingly irregular in their course and often terminating abruptly, so that little dependence can be placed upon them for mining, although the ore is very rich."

*Bog Iron Ore.*—Traces of bog iron are found in several places already alluded to. The fields behind the post office at Bridgeville, in the neighbourhood of a limestone quarry, are rusty with this mineral. A very rusty clay or impure bog iron is seen on the west bank of Debert River, above Shatter Brook; but is of no value. Deposits occur, according to Mr. Barlow, at Clarke's Head, Fullerton Lake and other places.

*Clay Iron-stone, Siderite, Ankerite, etc.*—The almost universal occurrence of veins containing carbonate of iron among the Devonian rocks, has been so often referred to in the course of this report as to require little further notice. They all seem to pass into, or to be mixed with specular iron ore and limonite. The spathic ore of McLaurin's (p. 74) has been described by Mr. Hartley. It is associated with greenish-grey grit, reddish flinty grit and sandstone, more like Cambro-Silurian than Carboniferous, but, perhaps, altered along a fault. It contains pebbles of syenite and felsite and others of reddish flinty grit. A reddish, impure limestone has been quarried and burnt for lime, and the iron ore may be a Carboniferous contact deposit.

East River Pictou.

*Limonite.*—Mining operations have been vigorously begun by two companies on a vein of limonite* which lies at the contact between the Carboniferous and Pre-Carboniferous rocks on the north bank of the East River of Pictou, above Springville. By one of these, the New Glasgow Iron, Coal and Railway Company, a railway thirteen miles in length has been constructed from Eureka (Ferrona), to Sunnybrae; and blast furnaces and coke ovens are being built at the former place.* By the second, the Picto Charcoal Iron Company, the excellent ore on the Grant farm a Bridgeville is being prospected, 230 feet above the river; and considerable quantity of it has been used for fettling at Londo derry. It is found here in large masses in the soil and also i place, mixed with traces of baryte, calcite, hematite, and othe minerals. A face of twenty-five feet of ore showed at the end o the opening, and more was said to lie beneath the floor. It is har and very pure, has cavities filled with botryoidal and laminate radiating ore, black or iridescent on the surface. On the west wal are shaly Silurian rocks, whilst on the north is a flinty compac rock. No Carboniferous is found in the cutting, but on the slope o the hill are pits denoting limestone or gypsum. West of this mine openings have been made on the right bank of Grant Brook. Th lowest tunnels run west forty-five feet. Another, thirty-five fee north-east, driven by the Londonderry company, is cut fift feet east and west, partly in red shale; and a shaft is on the top o the bank seventy feet from the mouth of the first tunnel. Here th ore was found to be soft, spongy and impure, about twelve fee Manganese. thick, mixed with calcite and manganese ore, chiefly psilomelane North-west of the ore is a rock which seems to be a soft trap.

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*Gesner's Geol., p. 63; Geol. Surv. of Can., An. Rept. 1886, vol. II., p. 115, P; Gilpin's Mines of Nova Scotia, p. 63; Reports of Commissioners of Mines for 1872, p. 37; for 1874, p. 51; for 1875, pp. 61, 69; Trans. N. S. Inst. Sc., vol. II., pp. 71, 72; vol. IV., pp. 138, 142; vol. V., p. 204.

Springville. At McGillivray's, near Springville, a large quantity of iron or debris is found near the buildings and also on the road near th contact of the Carboniferous; but the parent vein does not seem t have been yet discovered.

Where opened on the land of John S. Cameron in a pit, the vei was found to be twenty-one feet six inches wide. In the drift te stones of manganese ore to one of iron ore were found, but none *i situ*. At Donald McDonald's, the ore is twenty-five feet thick wit Fraser's. much manganese ore on top. At Fraser's (saddler), red slate, lik that at Grant's Brook, has been cut in a shaft sixty feet deep, th ore being nearly vertical and from twelve to fifteen feet thick. A Duncan Cameron's, a pit twenty feet deep cut five feet of ore Higher up the East River, about 125 yards above the fork of John McDonald's (Ogg) Brook, the ore is found to be two feet thick having on one side Carboniferous limestone, on the other trap. At Blackrock. the Blackrock workings, above McDonald's Brook, and 200 yards above the river road, a large quantity of limonite has been exposed, apparently less pure than that of Grant's, laminated and with the layers separated by seams of clay. These layers are divided crosswise into blocks, and these blocks have *vuggs* containing botryoidal concretions of limonite. Carboniferous limestone is in great masses along the lower part of the brook, while the "black rock" or massive trap rises a short distance above the workings. A little hematite and specular iron ore is found in the clay on the east side of a drift at the lower workings.*

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*Report of the Department of Mines, 1891, p. 47; Can. Min. Manual, 1890-91, p. 93; 1892, p. 186.

Drug Brook.

At the bottom of the old dam on Drug Brook, limonite is dug in Devonian slates, but not in such abundance as the boulders found in the drift of the vicinity would seem to warrant. Here and at Cullen's, pits, some of which were twenty-five feet deep, were sunk in 1882, and long tunnels extended from them. The ore is compact, brown, somewhat siliceous, botryoidal and radiated.

Brookfield.

Baryte.

A vein of limonite was found at Brookfield, by Mr. R. E. Chambers, and in 1888 about 1,000 tons were extracted for shipment to Londonderry. The ore is found among red, flinty Devonian slates, but in the neighbouring valleys, Carboniferous limestone and gypsum are largely developed. A large vein of baryte has been worked not far from the mine.

Upper Kemptown.

As already stated, a considerable quantity of limonite has been found among the Devonian rocks of Upper Kemptown, associated with specular iron ore. At Dan Munro's, it has been prospected in several shallow pits. The ore is black, radiated and botryoidal and occurs in greenish, grey, rusty-weathering and purple rocks, in veins six inches and more in thickness.

Londonderry.

Limonite changes in depth.

The veins of Londonderry mines are described by Louis.† The ore, which occurred as limonite on the surface at the first openings, changed, on working deeper, into ankerite and siderite with sometimes a large proportion of carbonate of lime. This fact may explain why little or no black or brown ores are found in the bottom of the ravines cut by the rivers. Wherever they go deep, that is due, Mr. Leckie says, to fractures in the rocks. The same change, it is said, takes place in the deep workings on the East River of Pictou. At the East mines, several large, open cuts were made during the summer of 1891, in veins containing a mixture of spathic iron ore and other carbonates with specular iron ore, the latter being in cracks or joints, veins and spots. Part of the vein is brecciated, containing fragments of the green slate of the iron ore series, and also apparently of the siderite, so that perhaps the veins which carry the specular ore are of subsequent origin and, as elsewhere, filled by sublimation in proximity to igneous rocks. The "white ore" may be in the same vein siderite, ankerite, dolomite or calcite, and has to be carefully selected. Two of the pits at present worked are those in Gory and Slack Brooks. At one of these a low tunnel was driven, several years ago, in the hope of striking the brown ore; but it cut only white ore. Professor Hind, in his report on part of the Cumberland coalfield, gives many facts concerning the iron mines.

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*Trans. N. S. Inst. Sc., vol. III., page 171; vol. V., p. 31; and Geol. Surv. of Can. An. Rept., 1886, vol. II., p. 115 P.

†Trans. N. S. Inst. Sc,, vol. V., p. 47. Cf. also op. cit., vol. II., p. 112; How's Mineralogy, pp. 84 and 105; Geol. Surv. of Can. Reports of Progr., 1872-3, p. 19 1873-74, p. 229; Gilpin's Mines of Nova Scotia, p. 59.

Totten's Brook.

The iron ore of Totten's Brook, as stated above,* lies on the side of a hill north of a little marsh, on the south side of which are outcrops of igneous rock. A long open trench has been made on the iron ore from which has been taken a large quantity of brown and whitish ankerite, containing films and blotches of specular iron ore and vuggs in which are plates of baryte. The vein runs 292°, dipping to the south-west, for 120 feet; then turns to 257° for 210 feet to the end of the trench. It is of variable thickness. For some distance the excavation is four feet and a half wide, but further west much wider. On the footwall are the light green, somewhat soapy argillites, showing films of specular iron ore at the west end; on the hanging wall, a reddish flinty argillite. On both walls and in the vein is a large quantity of yellow "paint." It has been opened again in a little brook to the westward.

Birch Hill and Clifton.

The small veins of limonite at Birch Hill, near Bass River, and the more important deposit at Clifton,† have been described with the Devonian. Tables of analyses of many of the iron ores of Nova Scotia are given by Mr. H. S. Poole in the Reports of the Department of Mines for 1874, pp. 80 and 81; for 1876, pp. 58-60.

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*P. 30; Gilpin's Mines of Nova Scotia, p. 60; How's Mineralogy; Geol. Survey of Can., Rept. of Prog., 1872-73, p. 35.

†Report of the Department of Mines for 1880, p. 15.

EXTRACTS from the Laboratory Book of the Londonderry Iron Company, Limited, Londonderry, N. S., General Manager, R. G. Leckie; Analysts: Henry Louis, J. S. Richmond, William Smaill.

| Sample No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Peroxide of iron | 99·39 | 48·72 | 71·81 | 54·18 | 65·64 | 90·79 |  | 50·35 |  | 74·63 | 86·74 | 84·29 | 68·94 | 49·48 | 77·91 |  |  |
| Protoxide of iron | 0·32 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Protoxide of manganese |  | 0·15 | 0·28 | *1·36 | 1·55 |  |  |  |  |  |  |  |  |  |  |  | 3·02 |
| Alumina |  | 5·90 | 3·59 |  | 3·90 |  |  |  |  |  |  |  |  |  |  |  | 5·00 |
| Lime |  | 10·44 | 2·30 | 12·76 | 5·05 | 0·92 |  |  |  |  |  |  |  |  |  |  |  |
| Magnesia |  | 0·78 | 1·00 | 2·10 | 0·80 |  |  |  |  |  |  |  |  |  |  | 0·427 |  |
| Phosphoric acid |  |  |  |  |  |  |  |  | 0·03 | 3·80 | 0·399 |  |  |  |  |  |  |
| Sulphuric acid |  |  |  |  |  | 1·38 | 1·26 |  |  |  |  |  |  |  |  |  | 0·57 |
| Volatile matter | Trace. | 8·52 |  | 18·04 | 10·24 |  | 5·20 |  |  |  |  |  |  |  |  |  |  |
| Insoluble matter | 0·58 | 23·96 | 18·13 | 5·48 | 11·97 | 5·10 | 3·50 | 35·80 | 12·90 | 11·00 | 10·28 | 12·87 | 5·00 | 15·00 | 9·00 |  | 26·50 |
| Metallic iron | 69·81 | 34·11 | 50·27 | 39·08 | 46·73 | 63·55 | 59·10 | 35·25 | 60·69 | 52·44 | 60·72 | 59·00 | 45·45 | 34·34 | 54·54 | 61·38 | 47·50 |
| Phosphorus |  |  |  |  |  |  |  |  | 0·01 | 1·66 | 0·17 |  |  |  |  | 0·18 |  |
| Sulphur |  |  |  |  |  | 0·55 | 0·54 |  |  |  |  |  |  |  |  |  | 0·23 |

*Mn.$_3$O$_4$

EXTRACTS from the Laboratory Book of the Londonderry Iron Company—*Continued.*

| Sample No. | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Peroxide of iron | | | | | | 58·74 | 58·01 | 51·44 | 66·22 | 63·79 | | | 26·39 | | | | |
| Protoxide of iron | | | | | | | | | | 23·88 | | | | | | | |
| Protoxide of manganese | Heavy trace. | | | | | | | 0·871 | | 0·08 | 1·81 | 1·51 | 12·74 | | | | |
| Alumina | | | | | | | | 6·70 | | | 3·71 | 6·00 | | | | | |
| Lime | | | | | | | | 0·18 | | 0·11 | 22·90 | 16·10 | | | | | |
| Magnesia | | | | | | | | 0·125 | | 3·27 | 2·88 | 8·25 | | | | | |
| Phosphoric acid | 0·414 | | | | | 2·674 | | 1·05 | | Trace. | Trace. | 0·075 | | | | | |
| Sulphuric acid | 0·196 | | | | | | | 0·123 | | Trace. | | | | | | | |
| Titanic acid | None. | | | | | | | | | | | | | | | | |
| Water | | | | | | | 34·30 | | | | | | | 6·73 | 5·63 | | |
| Volatile matter | | | | | | 6·07 | | 10·11 | | | | | | | | | |
| Insoluble matter | 10·12 | | | | 15·35 | 18·19 | | 25·00 | | 8·83 | 3·00 | 2·10 | 33·50 | 24·29 | 16·54 | 25·66 | |
| Metallic iron | 55·74 | 56·45 | 41·85 | 56·00 | 44·24 | 41·12 | 40·61 | 46·01 | 46·36 | 63·23 | 26·45 | 25·25 | | 44·18 | 49·22 | 36·19 | 24·55 |
| Phosphorus | 0·18 | | | | | 1·17 | | 0·46 | | | | 0·03 | | | | | |
| Sulphur | 0·08 | | | | | | | 0·05 | | | | | | | | | |

1. Specular ores. 2. Red hematite from Pictou River. 3. Red hematite, massive, from Nictaux. 4 and 5. Specular and ankerite, Totten's lot, East Mines; average. 6. Pyrites, calcined. 7. Specular ore, 14 samples from West Mines. 8. Specular ore from Parrsboro', Dr. Townshend's samples. 9. Magnetite from Lower Economy. 10. Red hematite from Torbrook. 11 and 12. Red hematite from Torbrook, the latter, the average of seven cars. 13. Red hematite from North River, lump. 14. Red hematite from North River, fine. 15. Red hematite from Cambridge, Hants county, Mr. W. F. Jennison's sample. 16. Best lumps of Torbrook ore. 17. Torbrook hematite; fine ore and rock matter. 18. Torbrook ore (J. T. D., Analyst). 19. Torbrook; average of seven cars. 20. Red hematite from Annapolis. 21. Average of Torbrook ore. 22. Average of 22 samples of limonite, chiefly from West Mines. 23. Brown hematite (mixed with red), from Horton. 24. West Mines. 25. Average of pile from West Mines. 26. Bog ore from Torbrook. 27. Magnetite from Five Islands. 28. Average sample of Totten Hill ore, East Mines. 29. Average sample of Slack's Hill. 30. Manganese ore from vein 4 ft. thick, Nictaux. 31. Average of 41 samples of brown hematite from Brookfield, taken from a very large quantity of the ore used in the furnace. 32. Brown hematite, average of 24 large samples from East River of Pictou. 33. Average of eight analyses of Canfield iron ore. 34. Average of 18 assays of white ores and ankerite. Silica less than one per cent, with traces of lime, magnesia and carbonate of manganese (0·68 to 2·63). When roasted the white ore has 30 to 58 per cent metallic iron.

*Hematite.*—Most of the samples of this mineral obtained from the various outcrops in the district contain more than twenty per cent of silica and have not been much used for iron making.

Exposures found among Silurian strata in contact with small patches of diorite have been developed a little between the heads of French and Sutherland Rivers. On the road between the church at McLellan's Mountain and the Brookville post office, red hematite was prospected, by Messrs. Holmes and Watson in 1884, by three pits, eighteen feet deep, sunk in grey earthy Silurian sandstone. Iron ore has also been found on the track from Squire Fraser's to the end of the road from the school at McPherson's mills.

French River.

At Webster's or South McLellan's Mountain, on the west side of the road, is a large opening on a bed of hematite, eight feet thick, mixed with siliceous rock and traceable for three-quarters of a mile to where it is only two inches thick and does not contain more than thirty per cent of iron. The ore and the adjacent white quartzose grit follow the high land, the Clinton slate being usually denuded. To the eastward between this point and the road it was opened beneath four feet of surface and is twelve feet thick. East of the road are what appeared to be two parallel beds, but Mr. Fraser supposes them to be the same. In the first large cutting east of the road there is a twenty-inch parting of slate in the ore and also at the next pits to the eastward, where the ore is richer, but still contains a large percentage of quartz in grains.

Webster's.

At Archibald Fraser's, on the Wentworth grant, on the left bank of Sutherland River, is a bluff outcrop of hematite,* forty feet wide in a north and south direction, apparently separating Silurian from Pre-Silurian slates. On his land east of a little lake, the ore is thirty-three feet wide from north to south and associated with fragmental slates. On the opposite side of the river, near Angus Fraser's house, the ore is in white quartzite, associated with pearly and felspathic slates.

Wentworth Grant.

Near the west branch of Blanchard Brook, the bed of red hematite, opened at Fred McDonald's, is in bluish-grey, somewhat massive, quartz-veined, Silurian rock, a trench in which, eighteen feet by twelve feet, exposes three feet or more of ore. Further north at William Ross's an ore bed of considerable but irregular thickness, full of fossils, is associated with dark trap. Still further north at McDonald's,† occurs the large bed. The ore here is lenticu-

Blanchard.

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*Trans. N. S. Inst. Sc., vol. IV., p. 140.

†Trans. N. S. Inst. Sc., vol. II., part IV., pp. 68-72; vol. IV., p. 140; vol. V., pp. 201 and 205; Canadian Naturalist, vol. VII., p. 129; vol. IX., p. 332; Reports of Department of Mines for 1872, p. 37; for 1874, p. 81.

larly interbedded with Silurian, is full of shells, oolitic, blotc with calcspar and sometimes very pure, although passing in ot places, as elsewhere stated, into rock which is merely stained w hematite. From this bed was quarried in 1828 the ore used by General Mining Association in their blast furnace at Albion Min At Evan McDougall's, hematite has also been found in Silurian ro

**Newton Mills.**

Several hundred tons of hematite have been mined at Newton Mi on Stewiacke River by the New Glasgow Company [p. 92]. The is of excellent quality, finely brecciated, and forms another of contact deposits at the base of the Lower Carboniferous. With iron ore or passing into it, is a reddish and grey impure limest containing shells; and overlying it at many points is a red calcare conglomerate, containing pebbles of whin and of other rocks. hematite has in places penetrated into the joints of the underly slates and reddened them for some distance. An analysis, made Mr. Graham Fraser by Tallock & Readman, of a sample of this showed it to contain:

| | In Sample as Drawn. | In Dried Sample. |
|---|---|---|
| Peroxide of iron | 68·97 | 69·14 |
| Protoxide of iron | ·24 | ·24 |
| Bisulphide of iron | ·29 | ·30 |
| Oxide of manganese | Trace. | Trace. |
| Lime | ·49 | ·50 |
| Magnesia | ·28 | ·28 |
| Alumina | 5·81 | 5·82 |
| Silica | 22·70 | 22·75 |
| Phosphoric acid | ·02 | ·02 |
| Titanic acid | None. | None. |
| Carbonic acid | None. | None. |
| Combined water | ·94 | ·95 |
| Mixture | ·26 | ..... |
| | 100 | 100 |
| Iron | 48·50 | 48·63 |
| Sulphur | ·15 | ·16 |
| Phosphorus | ·01 | ·01 |

**Tatamagouche.**

At Bailey's bridge, on the Little River of Tatamagouche, s veins in the schists show a mixture of calcspar and hematite w has been locally used as red paint.

*Specular Iron Ore.*—Explorations, made by Mr. H. W. Leslie the Nova Scotia Midland Company, east of John McDonald's (O

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*Patterson's History of Pictou, p. 425; How's Mineralogy, p. 97; Gilpin's M of Nova Scotia, pp. 63 and 67.

†Report of the Department of Mines for 1874, p. 51.

Brook, have developed a considerable quantity of this ore in veins and small pockets in a grey flinty Devonian rock. South of a little brook on the west side, Mr. Leslie has again found the ore and traced it nearly to the old pits on John McDonald's (weaver) land,* although nowhere so abundant as at the latter, where the ore is near the surface, either associated with or immediately north of large outcrops of black slate and quartzite. In the pits nearest the weaver's house, the specular ore contains numerous crystals of pyrite and veins of ankerite. The veins run approximately in the bedding of the rocks about 87°, and have been opened in a long trench and in a number of shallow pits. Search has also been made in the neighbourhood of Archibald's Brook. McDonald's.

The pits near the school at Marshdale are in trap, showing large blotches of specular iron. The Devonian slates of West River, about Watervale, contain ankerite and specular iron, widely distributed, but apparently only in small films and reticulating veins. Marshdale and West River.

On the right bank of Calvary Stream, at the driving dam, several small quartzose or siliceous veins have been developed containing specular iron ore in greenish-grey, wrinkled, more or less pearly, soapy, schistose slates, associated with ribbanded, flinty flags. As on the East River, black slates, lower down the stream, show a large quantity of graphitic matter. The veins of specular iron ore opened to the northward on Steele's Run are described on page 42. In the West Branch of Middle River, below Neil Matheson's mill,† this ore occurs in veins and blotches, sometimes six inches thick, in crystalline aggregations, and also in quartz veins in siliceous, rubbly, Devonian rocks. Calvary Stream. Graphite

*Bog Manganese.*—Small deposits of this ore, generally more or less mixed with bog iron, are of frequent occurrence but little value. On the hill south of Bridgeville it occurs in nodules and black earth. Concretions of bog manganese have also been found in the neighbourhood of Cameron (Meadows) Brook, not far from the pits mentioned above as cutting the Devonian altered rocks, spotted with crystals of pyrite. Above Glengarry, on a branch of Middle River, on Murdoch McKay's land, several shallow pits have been sunk on a deposit said to vary from six inches to a foot in thickness. Glengarry.

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*Gilpin's Mines of Nova Scotia, p. 68; Trans. N. S. Inst. Sc., vol. II., Part IV., p. 71; vol. IV., p. 142; vol. V., p. 206; vol. VIII., p. 509; Report of the American Association, 1879.

†Reports of N. S. Department of Mines for 1881, p. 15; for 1883, p. 23.

*Pyrolusite.*—The mode of occurrence, uses and localities of this ore of manganese are given by Professor How,* Sir J. W. Dawson,† and Mr. Gilpin.‡

**Farnham's Brook.**

From the appearance of the rocks at Farnham's millbrook, in which it occurs in pockets in grey and rusty, concretionary, massive Carboniferous limestone, lying unconformably on the Devonian, this ore seems to be a contact deposit. The limestone also contains much disseminated red hematite, which, on weathering, imparts to it mottled shades of colour.

**Manganese Mines.**

At the manganese mines of East Onslow, a regular shaft has been sunk to a depth of fifty-five feet; but the principal workings consist of an equally deep irregular open cutting in red Devonian sandstones or quartzites, which dip very steeply to the southward, and in which the ore occurs in the joints and bedding, like the specular iron in other places, following one band of the flinty rocks. Between the shaft and the quarry is an argillite or clay-rock which effectually keeps the water of the shaft from passing into the present workings. The ore-joints which are richest, have a steep westerly dip, in some places a foot of pure crystalline pyrolusite being obtained. A large quantity of ore found in the soil and broken debris of the surface was passed through a jig, worked by a twelve-horse-power engine which also pumps the mine. That from the mine is picked and sorted on the surface, separated from the rock and put into parcels, the high grade ore containing little or no impurity, the low grade containing more or less rock. A small quantity of whitish clay-rock is mixed with the ore, which contains also in places particles and wedges of stone which form with it a kind of breccia. The mine has been worked intermittently for twelve or fourteen years, as many as twenty-two men having been employed at one time. Mr. McLennan, the manager, estimates that it has yielded 150 tons of ore.

**Tenycape.**

The manganese mine of Tenycape lies about a mile south of the main shore road, three-quarters of a mile west of Tenycape Brook. On the road to the mine are outcrops first of dark slates, then of coarse and fine greenish grit, and near the mine, of reddish and grey flinty slate, immediately beyond which is Carboniferous limestone. The deposit seems to be similar to the limonite of Londonderry; it is in veins in the hard rocks, associated with calcspar, baryte and other minerals; large masses have been found weighing hundreds of tons. The mode of working followed by Mr. Joseph Stephens, the owner, resembles that described above. The ore follows the bedding in a vein of variable breadth, a hard belt being above and soft rock below; and a cutting has been extended several hundred yards along it. Some of the ore is pure enough to use without dressing; but much of it is crushed, washed and jigged.

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*Trans. N. S. Inst. Sc., vol. I. (3), p. 128; Mineralogy of N. S., pp. 110-126.

†Acadian Geol., p. 273.

‡Mines of N. S., p. 90; Report of the Department of Mines for 1885, p. 72: Trans. Roy. Soc. Can. vol. II., sec. IV., pp. 7-13.

*Copper Ores.*—The presence of unimportant traces of copper ore has been indicated in the foregoing descriptions of the rocks of various localities.

In metamorphic rocks.

Small pockets and crystals of copper pyrites are found at several places in the neighbourhood of McLellan Mountain, in or near the Cambro-Silurian igneous rocks. Above the mills at Rocklin, traces of ore are found in dark Devonian slates, also in minute quartz veins on the west branch of Middle River, in a brook near Pembroke, and in other places, and perhaps the pits in the polished, shiny, graphitic shales of the Cross Brook of Lorne, which contain veins and layers of dark and light-coloured limestone and calcspar, with numerous specks of pyrite, were sunk in search of copper ore.

Recent explorations have developed a considerable quantity of copper ore among the felsites near Pinkietown, at the head of the Ohio River, of Antigonish.* Near the head of Six Mile Brook, copper pyrites is found associated with the felsites and diorites of Mount Dalhousie.

In unaltered strata.

Another class of deposits includes those found in concretionary rocks, chiefly Permian, in association with trunks of trees and other carbonized matter. On the West River below Durham, patches of greenish and grey conglomeratic rock in red sandstone have been mined for copper ore, which, like that of Pomquet and other places, consists of stems of plants, in part carbonized in part turned into copper ore and containing besides much concretionary calcareous matter; in Middle River on a little brook below and nearly opposite the Millbrook; and on the East River near Hopewell,† a similar ore is found. Opposite Angus Bailey's house on River John, grey copper ore was prospected in a grey sandstone. In the same neighbourhood on "The Brook," a spotted sandstone, marked with carbonized plants, has been dug for copper; and on the shore opposite the Presbyterian church at River John, and also in Plainfield Brook near the fork, many nodules of copper glance have been found. In Scotsburn

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*Geol. Surv. of Can. An. Rept., 1886, vol. II., p. 122 P.

†How's Mineralogy, pp. 71, 72 and 208.

Brook, a pit twenty feet deep is said to have exposed a band of cupriferous sandstone five feet thick: and several hundred dollars were spent in mining here, while as many thousands were proably spent on the French River.* The copper ore of Plainfield, Caribou, Toney River, French River and Malagash is described on pp. 130, 135 and 138. The mode of occurrence of that of Waugh River, about three miles from Tatamagouche, is thus described by Professor M. E. Wadsworth:† "The country rock is a sandstone composed of granitic detritus, and contains clay, fragments of lignite and other carbonaceous materials. Associated with this sandstone are intercalated beds of red shale, some of which is of so fine a quality that it has been used as a mineral paint. All these rocks dip N. 20° E. $< 26°$. The ore is in nodules and lenticular masses composed of chalcocite or its hydrous carbonate [malachite] scattered through the beds of sandstone and shale. It is so associated with the carbonaceous materials in the rocks that it is believed that the copper was collected by the percolating waters, precipitated and reduced by the organic matter, and thus collected into the masses found at present, many of which are now in part lignite and in part chalcocite. The change to the carbonate is, of course, a still further change, wrought through the medium of the percolating waters."‡

Tatamagouche.

Native copper.

The native copper associated with the zeolites and other minerals of the trap of Minas Basin is described by Professor Wadsworth as occurring in the basaltic rocks (melaphyrs and diabases) disseminated in part through them and in part occurring in veins in relations similar to those observed on Lake Superior and produced by the action of percolating waters (whether thermal or not) in collecting the copper disseminated through the old basaltic lavas and concentrating it in whatever suitable receptacles existed in the lavas and their associated conglomerates, and in the fissures traversing them.

Stewiacke.

*Galena.*—This ore of lead has been worked to a small extent a Smithfield and Pembroke on the north side of Stewiacke River i Carboniferous limestone, in which it occurs in small veins and disseminated crystals. At Smithfield, galena, pyrite, blende an calcspar are intermixed in what appears to be a brecciated vein the contact of the limestone with quartz-veined Devonian rocks. Here an engine and smelter were erected to work and reduce the ore. At Pembroke a considerable sum of money was spent in searching for galena in a fossiliferous limestone, also near the contact with red and grey Devonian slates.*

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*How's Mineralogy of Nova Scotia, p. 69.

†Proceedings of the Boston Society of Natural History, vol. XXIII., p. 204.

‡Gesner's Geol. and Miner. of Nova Scotia, pp. 139, 140; Indus. Res., p. 28 Am. Journ. Sci,, 1828 (1), XV., 151-153; Trans. Am. Acad., 1831 (2), I., 289-29 Dawson's Acadian Geol., pp. 327, 345, 346; Report of the Department of Mines N. S., 1876, p. 63; 1877, pp. 48, 49; 1879, p. 13; 1880, pp. 75-77; Gilpin's Mines N. S., p. 76; Journ. Geol. Soc., London, vol. IV., p. 511.

*Silver.*—The erratic search made for silver on the Little River of Stewiacke, on John McDonald's (Ogg) Brook and in other places seems in most cases to have been instigated by the presence of scales of specular iron ore among the rocks.

*Gold.*—The occurrence of gold on the Atlantic coast in quartz-veins has led to the search for it wherever such veins traverse the newer rocks. Thus those of the Silurian rocks of the East and Sutherland's Rivers and of McLellan's Brook,† and of the Devonian of West River, Riversdale, Folly Mountain, Tatamagouche Mountain and Irwin Lake, have at various times been prospected. On Bailey's Brook, south of West River station, a shaft was sunk thirty feet in blackish Devonian argillite, cut by a vein or band, three feet thick, of whitish, greenish and rusty calcareous clay-rock, resembling a decomposed felsite, containing graphite and calcspar in the numerous planes, and minute crystals of pyrite; and other pits have been sunk in the vicinity.

Florida road.

A company was formed, twenty-five or thirty years ago, to search for gold at the point marked "Gold mine," near the Cumberland line on Church's map of Colchester county; but after a little work the search was abandoned. About forty-five years ago, when the land was cleared of a second growth of trees, some of which were ten inches through, hundreds of pounds of ox bones were, it is said, found beneath the soil. These were supposed to have been left at an old camp ground by the Acadians before their expulsion, the road between their settlements at Masstown and Tatamagouche having, it is said, followed the pass between the Millbrook and Debert River in preference to that taken by the Intercolonial railway. Led by some traditions, this camp was assumed to have been used by the French when mining for gold, grains of which have, it is said, been obtained from boulders and from washing the sand. In the mountain, however, only black crumbly trap and diorite, were seen, with quartz veins like those, also reported to carry gold, on the railway near Folly River.

Reference has been already made to the abortive attempts made to work the conglomerates of Brookfield, Glenbervie and other places for gold.‡

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*Report of the Department of Mines for 1887, p. 47.

†Trans. N. S. Inst. Sc., vol. III., pp. 39 and 73.

‡Summary Report of the Geol. Surv. of Can. for 1890, p. 41.

*Limestone.*—Nearly all the principal localities in which limes has been quarried, for lime making, for manure or as a flux, been already referred to in the course of this report and are sh on the map. With very few exceptions it is obtained from Lower Carboniferous. Among the more important quarries those of McLellan's Mountain and Brook, and of Bridge Springville, Churchville and Lorne on the East River of Pi Near Hopewell, limestone has been worked on Halliday's, Gra McDonald's and other farms, but the largest quarry is prob that at Dunbar's, where a light grey and blackish, massive, minous and vesicular, compact limestone contains spots of hem and blotches or veins of calcite and ankerite and yields many c and shells.*

The quarries of Brookfield are referred to on p. 94; thos Penny's Mountain, on p. 92; of Beaver Brook, on p. and of Kirkhill, on p. 172; they require no further mention.

The Devonian limestones of the West River and Waters' Hill been described with the Devonian. That of Gordon's quarry, Glengarry, is mixed with trap and is not like the Carbonife limestone of the vicinity, but rather crystalline, like that of East River near Glencoe. It is said to be hard to burn becau melts; it requires a quick fierce heat, but when burnt, mal good white lime, requiring two bushels of sand for mortar. crystalline Devonian limestone of Phinney's Brook† is describe p. 71.

A small quantity of the Permian limestone of Cape John h is said, been exported to Prince Edward Island.

*Dolomite.*—An analysis made for Mr. Leckie by Mr. Wil Smaill, the analyst at Londonderry mines, of a sample of magn limestone from the quarry opened by Mr. Jamme west of th Cumberland road, yielded :—

| | |
|---|---|
| Protoxide of iron | 1·482 |
| Alumina | 3·942 |
| Lime | 28·750 |
| Magnesia | 14·017 |
| Volatile matter | 48·913 |
| Silica | 2·050 |
| | 99·154 |

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*Trans. Roy. Soc. Can., vol. IV., sec. IV., pp. 159-166.

†Gesner's Geol., p. 113.

As already remarked, others of the Devonian limestones are dolomitic. The Carboniferous limestones of East Onslow, Kennetcook and Shubenacadie are described by Professor How.*

Plaster mills.

*Gypsum.*—The great workable deposits of gypsum in the Lower Carboniferous have been described above. At a mill erected for the purpose at McQuarrie's plaster quarry near Lorne, 300 or 400 barrels were ground previous to 1885, and either used for the land or boiled for the finish in plastering houses. Another mill on Irwin Brook at Clifton, has also been allowed to fall into ruin. Fine outcrops, said to cover thirty or forty acres, of white and dark gypsum were quarried, about twenty years ago, on the east side of and near the mouth of Wallace Harbour. Statistics of the production of the quarries at present in operation are to be found in the annual reports of the Commissioner of mines and of the Division of mineral statistics and mines.

*Salt.*—At Bridgeville a salt spring issues from beneath a cliff of gypsum; and similar springs are found in various parts of the Carboniferous areas.† On the West River of Pictou, about 1813,‡ an attempt was made to manufacture salt at Saltsprings, and a shaft, 200 feet deep, sunk to find the bed of salt; but the company failed and sold the plant for old iron. About ten years later, salt was manufactured from the brine of the spring; but the work was soon abandoned.

*Mineral Water.*—"A water with a strong acid reaction is reported to exist near Gairloch, Pictou county. Springs, locally famous, are found at Earltown and Shubenacadie."§

*Clays.*—Among the various deposits of clay, one on the Middle River of Pictou has been utilized by Mr. Cameron of Stellarton, and a large plant established for the manufacture of bricks. It is a thick bed of dark-red clay situated immediately south of Sylvester station on the left bank of the river.

*Fireclay.*—Various analyses of fireclays from the neighbourhood of the coal seams in the Pictou coalfield are given by Professor How and Mr. Gilpin.|| Mr. Henry S. Poole in one of his reports

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*Min. of N. S., p. 155.

†Gesner's Industrial Resources of N. S., p. 264.

‡Patterson's History of Pictou, p. 273; How's Mineralogy of N. S., p. 143; Gilpin's Mines of N. S., pp. 100 and 102.

§How's Mineralogy p. 199.

||Geol. Surv. of Can. An. Rept., 1886, vol. II., p. 125 P; Mines of N. S., p. 113; Trans. N. S. Inst. Sc., vol. IV., p. 144.

as Inspector of Mines,[*] gives analyses of fireclays from the De seam and from Lingan and Springhill, comparing them with t Scotch and English varieties. "The Nova Scotian clays contain much larger percentage of alkalies, which are especially det mental to the quality of a fireclay. The presence of any quanti of iron and lime is generally injurious; though there are noticeal exceptions, Stourbridge of the one, and Pease's West Ganister the other ..................The Dominion imported in 1873-74, fire-bric for refractory linings for stoves, ovens and furnaces, to the value $78,040, and fireclay to the value of $10,873............... . The St Company of Canada alone imported in 1875 about 2,000,000 fi bricks for their establishment at Londonderry." Mr. R. E. Chambe states that the quantity used in 1892 by the New Glasgow Irc Coal & Railway Company in the construction of their furnaces w 850,000; by the Pictou Charcoal Iron Company, 100,000. A dark fi clay has been extracted from a tunnel on the west bank of the Ea River of Pictou near Stellarton. The tunnel is thirty yards long a the dip of the rock at the end is 327° < 70°, indicating a sm fault, which is also shown in the bank.

The occurrence of a fireclay, resembling that of Coxheath,[†] amo the felsitic rocks of New Annan has been mentioned on p. 156.

*Building Stone.*—"There is no country, probably," says Profess How, "better furnished with the varieties of stone suited to t purposes of the civil engineer, the builder and the architect."[‡] T principal quarries of building stone, which are, for the most pa among Permian strata, have been mentioned in the course of this r port. The grey beds of the quarries at Pictou, the Four, Six and Eig Mile Brooks of the West River produce a valuable building a monumental stone. Of the latter the two best are probably tho of the Elliott and McPherson quarries on the Six and Eight Mi Brooks respectively. The stone is sold at the Elliott quarry for $ per cubic yard or 63 cents a cubic foot. McKeen's, about a mi east of Pictou, shows a face of forty feet of good grey freeston On Rear Brook and at various points on the East River are quarri of grey sandstone and flags.

The sandstone quarried on Toney River, three-quarters of a mi above the shore road, is a striped or banded, dark grey variet with bedding stripes of lighter colour, the whole having a reddis grey tinge. It breaks into long blocks two feet thick and downward. Some of the brown stone quarried by Mr. R. E. Chambers from the shore near Toney River was shipped by rail to Almonte, Ont., where it was used in one of the public buildings. The celebrated red freestone quarries of River John, Cape John and Tatamagouche have already been referred to. From that of Mr. Rogers, above the village, a specimen was sent to the Paris Exhibition.

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[*] Department of Mines, Nova Scotia, 1875, pp. 66-68.

[†] Geol. Surv. of Can. Repts. of Progr., 1879-80, p. 125 F; 1875-6, pp. 423 and 37 and 1873-4, p. 173

[‡] How's Min., p. 169; Gesner's Geol. of N. S., p. 141.

*Grindstones.*—Many of the grey sandstones referred to above have been largely quarried for grindstones, but require no special mention. The aggregate value of the building and grindstone exported from Pictou in the seven years, 1860–66, is given by Professor How as $25,094; in 1874 188 tons, valued at $1,448, were exported, and in the four years from 1882 to 1885, 929 tons valued at $5,584.

*Whetstones, Scythestones, &c.*—The excellent scythestone of Birch Hill is a fine, grey sandstone, apparently Lower Carboniferous, with sharp grains of silica, found in the neighbourhood of the East Brook of Stewiacke. Among the Silurian rocks of the hills north-east of Earltown, are bands locally used for whetstones. They are usually dark grey and good, if kept wet or oily. Good whetstones are also found among the same strata at John McKay's (Ross.)

*Marble.*—The marble of the East River, near the mouth of John McDonald's (Ogg) Brook, has been already described.* Where exposed in the river it is full of rusty blotches. That found in the metamorphic rocks of Five Islands (p. 160) is described by Professor How† as of two kinds—a pure white variety, of excellent grain and great beauty when polished, and a green and white variety. A block shipped to England in 1852 was, on arriving there, pronounced to be unserviceable from being shattered.

*Syenite, Porphyry, &c.*—Some of the varieties of these rocks met with in the mountains are probably fit for building and ornamental purposes, but none have been utilized. Among them is a syenite of Upper Kemptown, a bright-red, fine grained variety, associated with dioritic rock.

*Baryte.*—Reference has been made to the frequent association of this mineral with the ores of iron and manganese. It is found also in small veins and crystalline aggregations, mixed with calcspar in Permian rocks, in many of the branches of River John, above John McKay's, near Mrs. Morrison's, on Nabiscump Brook, near Peter River John.

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*Geol. Surv. of Can. An. Rept., 1886, vol. II., p. 126 P; Trans. N. S. Inst. Sc., vol. III., pp. 64, 65; vol. IV., p. 466; vol. V., p. 208; How's Min., p. 158.

†Min. of N. S., p. 157.

Gratto's mill, near McBean's house, and at Welsford between th mills and the shop. In one conglomerate the pebbles are hel together by a white crystalline calcspar mixed with baryte. It wa quarried to some extent in the grey sandstone of Hodson nea River John, some years ago, the quantity exported in 1879 amoun ing to 480 tons, valued at $2,400;* but at present none of the vein are worked.

Brookfield. About six miles east of Brookfield station, or a mile west of Bi Putnam's Brook, and half a mile north of the Stewiacke River, is deposit described by Professor How,† from which 1,200 tons ar said to have been taken prior to 1868 from a shaft or cu ting forty feet deep. The ore was in three veins, having a average thickness of eighteen inches, white throughout o with a greenish tinge in part, perfectly free from pyrite an other metallic minerals, but containing traces of graphite. Th veins seem to traverse irregularly a grey somewhat argillaceou limestone. Small veins of bright red calcspar also cut the lim stone, which is associated with greenish-grey, fine, calcareous san stone and flags, marked with carbonized plants, and with blackis coarse grit, in which a small streak of coal is reported to have bee found. In the neighbourhood of the iron mine at Upper Broo field, a vein of reddish and white baryte, said by Professor How t be fifteen feet in thickness, is exposed on the side of the hill, mixe with iron ore. These deposits are still intermittently worked.

Five Islands. White and reddish baryte has been quarried‡ in considerabl quantity from numerous irregular veins, sometimes three feet wid or beautiful crystalline masses in the slates on the steep banks of th East and Bass Rivers of Five Islands, perhaps in continuation of th iron ore belt of the Londonderry mines. It is associated with specula iron, and carries a little copper pyrites and fine crystals of dog tooth spar and calcspar. About five hundred tons had bee exported to the United States before 1866.

*Graphite.*—Graphitic shale occurs in many places, as alread stated, but none of the known deposits seem to have been worke with profit. Professor How mentions having examined specimen from a vein at Partridge Island and from Salmon River.

*Infusorial Earth.*—Many of the lakes in which this material ha been found are mentioned in last report.§ It has also been taken from a little lake east of the Tatamagouche road at Corktown and from a creek or stillwater flowing from it; from a spring or pond in front of Mr. Crowe's house in the same vicinity; and also from a stillwater near the head of the west branch of Economy River.

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*Gilpin's Mines of Nova Scotia, p. 99; Report of Department of Mines, 1879, 55.

†Min. of Nova Scotia, p. 160.

‡How's Min., p. 160; Acadian Geol., p. 592.

§Geol. Surv. of Can. An. Rept. for 1886, vol. II., p. 127 P.

*Sand.*—Promising beds of moulding sand are found at Onslow and near the mouth of McLellan's Brook.*

*Slate.*—In Drug (Truagh) Brook, above the post road, is a bluish-grey slate, like that of Guysboro' Intervale;† in the Middle River above Lansdowne, flaggy Devonian slates have been quarried for buildings; and from the West and Stewiacke Rivers good specimens have been obtained.

*Precious Stones.*—Many beautiful minerals of the quartz family—amethyst, chalcedony, agate, jasper, opal, &c.—are described by Jackson and Alger, Dr. Gesner,‡ Professor How,§ Marsh,|| Gilpin,** Dawson,†† Hoffmann‡‡ and others, who have also devoted much time to the collection and determination of the various beautiful cabinet minerals so abundant in the trap areas of the Bay of Fundy.

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*How's Mineralogy of Nova Scotia, p. 162; Trans. N. S. Inst Sc., vol. IV., p. 145.

†Geol. Surv. of Can. An. Rept., 1886, vol. II., p. 128 P.

‡Geol. of Nova Scotia.

§Min. of Nova Scotia, pp. 180 and 202.

||Silliman's Journal, 2nd series, XXV., p. 210.

**Mines of Nova Scotia, p. 117.

††Acadian Geol., p. 114.

‡‡Annotated List of the Minerals occurring in Canada; Trans. Roy. Soc. Can. vol. VII., Sec. III., 1889; Geol. Surv. of Can. An. Rept., 1888-89, vol. IV., T.

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# REPORT

ON

# NATURAL GAS AND PETROLEUM

## IN ONTARIO

## PRIOR TO 1891

BY

H. PEARETH H. BRUMELL, F.G.S.A.

*Assistant to the Division of Mineral Statistics and Mines*

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OTTAWA, 7th July, 1891.

To ALFRED R. C. SELWYN, C.M.G., LL.D., F.R.S., &c.,
Director, Geological Survey, Ottawa.

SIR,—I have the honour to submit herewith a report on natural gas and petroleum operations throughout the province of Ontario, bringing down the history of such to the close of 1890.

Accompanying the report are illustrative sections, plans, and a sketch map showing the extent of boring operations in Ontario.

I have the honour to be, sir,
Your obedient servant,

H. PEARETH H. BRUMELL.

# INTRODUCTION.

Introduction.

The object of this report is to give in a concise form a description and narrative of boring operations undertaken in the province of Ontario, up to and inclusive of the year 1890. All wells sunk, whether searching for salt, petroleum, natural gas or water, have been included. These operations show that there is in southern Ontario, *i.e.*, that part lying south-west of a line drawn from Georgian Bay to Kingston, a possible thickness of Palæozoic rocks, and including the drift, of 4,200 feet as follows:—

Thickness of Palæozoic rocks.

| | | | | | | |
|---|---|---|---|---|---|---|
| | Drift | 0— 150 | feet | = | 75 | feet |
| Devonian | Portage and Chemung | 25— 200 | " | = | 100 | " |
| | Hamilton | about 350 | " | = | 350 | " |
| | Corniferous | 160— 300 | " | = | 230 | " |
| | Oriskany | 6— 25 | " | = | 15 | " |
| Silurian | Lower Helderberg<br>Onondaga | 300—1000 | " | = | 650 | " |
| | Guelph | 140— 160 | " | = | 150 | " |
| | Niagara | 100— 130 | " | = | 115 | " |
| | Clinton | 30— 150 | " | = | 90 | " |
| | Medina | 600— 800 | " | = | 700 | " |
| Cambro-Silurian | Hudson River | 500— 900 | " | = | 700 | " |
| | Utica | 300— 400 | " | = | 350 | " |
| | Trenton<br>Black River | 600— 750 | " | = | 675 | " |

The question of the origin of the hydrocarbons has not been gone into to any extent, though in Part I. of this report the salient points in the many theories advanced are given. It is now earnestly requested that drillers and others interested in boring operations throughout Canada should enter into correspondence with this office, that the information thus available may be made as complete as possible. For this purpose blank forms for records of boring will be supplied, as well as bottles or boxes for the preservation of samples of drillings.

Definition of petroleum.

Throughout this report the term petroleum (rock oil, mineral oil, etc.), is understood to refer to that mineral in its broadest commercial sense, and to include all varieties of the mineral in its fluid or semi-fluid state. The petroleum of Lambton, the only oil-producing county in Ontario, is a dark brown and heavy oil, ranging in gravity from 31½° to 35° Beaume, the heavier oil being obtained in the Petrolea field, while the latter is produced in that of Oil Springs and the smaller pool of Euphemia. The oil, as produced, has a very pungent odour of sulphur, which it contains in a form as yet undetermined, differing in this respect very materially from the oils of most of the United States fields. I have been unable to obtain any accurate analysis of Canadian oil, but its composition is approximately, carbon 85, hydrogen 15, the proportions varying with any variation in gravity, *e.g.*, the heavier the oil the greater the proportion of carbon. The actual commercial contents of Canadian oil, according to the returns of refiners during 1889, were :—

| | |
|---|---|
| Illuminating oils | 38·7 |
| Benzine and naphtha | 1·6 |
| Paraffine and other oils (including gas, paraffine, black and other lubricating oils and paraffine wax) | 25·3 |
| Waste, not returned (including coke, tar and heavy residuum) | 34·4 |
| | 100·0 |

**Definition of natural gas.**

Natural gas is understood to consist essentially of marsh gas with small quantities of hydrogen, nitrogen, etc., and to have a gravity compared with air of from ·560 to ·850. According to Prof. Ed. Orton,* the natural gas of Findlay, Ohio, is composed of :—

| | | | |
|---|---|---|---|
| Hydrogen | 2·18 | per cent | by volume. |
| Marsh gas | 92·60 | " | " |
| Carbonic oxide | 0·50 | " | " |
| Olefiant gas | 0·31 | " | " |
| Carbonic acid | 0·26 | " | " |
| Nitrogen | 3·61 | " | " |
| Oxygen | 0·34 | " | " |
| Hydrogen sulphide | 0·20 | " | " |
| | 100·00 | | |

Specific gravity compared with air, ·585.

**First discovery.**

As previously stated, the only oil-producing territory in Ontario is in Lambton county, to which district attention was first drawn in 1860 or 1861 by a Mr. Tripp, who owned a farm where now stands the village of Oil Springs. This gentleman, on excavating a well on his property for water, was struck by the appearance of an inspissated petroleum—known locally as "gum beds"—and also by the fact that black "rock oil" accumulated in considerable quantity on the surface of the water. The attention of Mr. J. H. Williams, of Hamilton, was drawn to the spot, and work in search of the oil than began in earnest. It was found that the deeper the wells were sunk into the Erie clay (which constitutes in a great measure the surface deposits of the district), the greater was the accumulation of oil. Drilling was then resorted to, and wells were bored into the rock. Through lack of experience, drilling was a very tedious operation, the only appliance then in use being the old-fashioned "kicking-rig," operated by the weight of the human body.

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* Geological Survey of Ohio, vol. VI., page 538.

Flowing wells.

The first flowing well was struck on the 19th February, 1862, when Mr. James Shaw, of Oil Springs, found oil at a depth of 160 feet in what is now known as the "Upper Vein." Following closely upon this discovery was a rush to the new oil field, and the business passed through the various stages of speculation and finally reached a solid business steadiness in 1867, when the celebrated "King Wells" were sunk in Petrolea. On the discovery of these wells oil at once fell to 20 cents per barrel, but means were found to store the surplus and prevent the almost criminal waste which had attended the discovery of large wells sunk but a few years previously in Oil Springs.

List of large flowing wells.

Dr. Alex. Winchell has given a vivid description of the early workings at Oil Springs.* He also gives † the following list of 33 flowing wells in Enniskillen township and their capacity prior to 1867 :

| Depth in feet. | | Situation. | Daily flow, barrels. |
|---|---|---|---|
| 104 | Salis | Lot 18, Con. II | 600 |
| 108 | Purdy | " 19 " II | 1,000 |
| 115 | Evoy Bros | " 19 " II | 600 |
| 116 | Jewry & Evoy | " 19 " II | 300 |
| 116 | Fairbanks | " 17 " II | 500 |
| 130 | Campbell | " 19 " II | 200 |
| 132 | Bennett Bros. | | 500 |
| 136 | Chandler | " 18 " II | 100 |
| 155 | Jewry & Evoy | (same as above, bored deeper) | 2,000 |
| 157 | Sifton, Gordon & Bennett. | Lot 18, Con. II | 150 |
| 158 | J. W. Sifton | " 18 " II | 800 |
| 158 | Shaw | " 18 " II | 3,000 |
| 160 | Wanless | " 18 " II | 200 |
| 160 | McLane | " 18 " II | 3,000 |
| 160 | Ball | " 18 " II | 250 |
| 160 | Rumsey | " 18 " II | 250 |
| 160 | Whipple | " 18 " II | 400 |
| 163 | Sanborn & Shannon | " 18 " II | 2,000 |

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*Sketches of Creation, 1870. Chap. XXV.

†Ibid, note VIII., page 443. Appendix.

of Euphemia. The oil, as produced, has a very pungent odour of sulphur, which it contains in a form as yet undetermined, differing in this respect very materially from the oils of most of the United States fields. I have been unable to obtain any accurate analysis of Canadian oil, but its composition is approximately, carbon 85, hydrogen 15, the proportions varying with any variation in gravity, *e.g.*, the heavier the oil the greater the proportion of carbon. The actual commercial contents of Canadian oil, according to the returns of refiners during 1889, were :—

| | |
|---|---|
| Illuminating oils | 38·7 |
| Benzine and naphtha | 1·6 |
| Paraffine and other oils (including gas, paraffine, black and other lubricating oils and paraffine wax) | 25·3 |
| Waste, not returned (including coke, tar and heavy residuum) | 34·4 |
| | 100·0 |

**Definition of natural gas.**

Natural gas is understood to consist essentially of marsh gas with small quantities of hydrogen, nitrogen, etc., and to have a gravity compared with air of from ·560 to ·850. According to Prof. Ed. Orton,* the natural gas of Findlay, Ohio, is composed of :—

| | | |
|---|---|---|
| Hydrogen | 2·18 | per cent by volume. |
| Marsh gas | 92·60 | " " |
| Carbonic oxide | 0·50 | " " |
| Olefiant gas | 0·31 | " " |
| Carbonic acid | 0·26 | " " |
| Nitrogen | 3·61 | " " |
| Oxygen | 0·34 | " " |
| Hydrogen sulphide | 0·20 | " " |
| | 100·00 | |

Specific gravity compared with air, ·585.

**First discovery.**

As previously stated, the only oil-producing territory in Ontario is Lambton county, to which district attention was first drawn in 1860 1861 by a Mr. Tripp, who owned a farm where now stands village of Oil Springs. This gentleman, on excavating a well on his p perty for water, was struck by the appearance of an inspissated petrole —known locally as "gum beds"—and also by the fact that black "r oil" accumulated in considerable quantity on the surface of the wa The attention of Mr. J. H. Williams, of Hamilton, was drawn to spot, and work in search of the oil than began in earnest. It found that the deeper the wells were sunk into the Erie clay (which constitutes in a great measure the surface deposits of the district), the greater was the accumulation of oil. Drilling was then resorted to, and wells were bored into the rock. Through lack of experience, drilling was a very tedious operation, the only appliance then in use being the old-fashioned "kicking-rig," operated by the weight of the human body.

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| Depth in feet. | Situation. | | | Daily flow, barrels. |
|---|---|---|---|---|
| 163 | Campbell & Forsyth | Lot 18, | Con. II | 1,000 |
| 163 | Wilkes | " 18 | " II | 2,000 |
| 164 | Bradley | " 18 | " II | 3,000 |
| 167 | Webster & Shepley | " 18 | " II | 6,000 |
| 170 | Leavenworth | " 18 | " II | 500 |
| 170 | Culver | " 18 | " II | 200 |
| 173 | Allen | " 17 | " II | 2,000 |
| 175 | Barnes | " 17 | " II | 300 |
| 178 | Petit | " 19 | " II | 3,000 |
| 180 | George Gray | " 17 | " II | 150 |
| 180 | Holmes | " 19 | " II | 500 |
| 187 | McCall | " 17 | " II | 1,200 |
| 188 | Swan | " 18 | " II | 6,000 |
| 212 | Fiero | " 19 | " I | 6,000 |
| 237 | Black & Mathewson | " 17 | " I | 7,500 |

**Efforts on part of prospectors to find gas.**

There are several points in connection with the production and utilization of natural gas, which may perhaps be here usefully referred to, especially the ill-directed efforts on the part of prospectors to procure it and the many thousands of dollars thus spent in regions where the geological conditions preclude all possibility of success and through a knowledge of which this useless expenditure might have been avoided.

In writing on the *anticlinal theory*, Prof. I. C. White states:—"The first explorers assumed that gas could be obtained at one point as well as another, provided that the earth be penetrated to a depth sufficiently great; and it has required the expenditure of several hundred thousand dollars in useless drilling to convince capitalists of this fallacy, which even yet obtains general credence among those not interested in successful gas companies."*

The words "several hundred thousand dollars" do not yet, fortunately, apply to those already spent in useless drilling in Ontario, though that there have been large sums uselessly spent will be acknowledged. Where in a district rocks elsewhere known to be gas-bearing have been proved to be "flooded," and the geological structure is that of a syncline rather than anticlinal, the chances of obtaining gas in paying quantity will be small, and again, in any district where the rocks have, through disturbance, been greatly fissured, it would be useless to expect to find gas, as it would long ago have escaped, or so lessened its pressure as to afford but meagre flows. The value of a

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*"*Science*," 26th June, 1885.

knowledge of geology, it seems, is not recognized by the average practical driller, who is influenced more by a "promising" (?) contour than by geological facts.

Waste of gas.

Attention has time and again been called by United States writers on the subject, to the almost criminal waste of gas by consumers and by owners of wells, the production of which is consumed only by themselves. For instance, many owners think it necessary to consume the *whole* daily flow of their well, never recognizing the fact that the rocks so long the reservoir of the gas contain only a limited supply that may with due economy be made to last the longer. Lime burners and brick manufacturers particularly allow much more fuel to be consumed than is necessary, because they think it costs nothing. The fact that the supply is diminishing may cause them to be more careful in the future, though the loss will then be irreparable, as a well has a certain life which can be prolonged only by care and economy. The indiscriminate lighting of towns and villages by torches is another danger to any gas district, as great quantities are thereby consumed with no better result than would be obtained through the use of a small pressure burner. Experience, however, will be the only teacher, and it is to be hoped that the lesson will be learned as cheaply and as soon as possible.

There are many other points of interest to the gas producer, information on which may be found in the reports of the Geological Surveys of Ohio, Pennsylvania and other states wherein gas is an important product. Attention is particularly directed to the report of the Geological Survey of Ohio, vol. VI., by Prof. E. Orton.

Appendices.

With the present report the following appendices are given :—

A.—Table for the conversion of specific gravities into their corresponding gravities according to Beaume's hydrometer;

B.—Cost of "drilling-rig" complete, at Petrolea, Ont., F. O. B.;

C.—Bibliography.

Acknowledgments.

My acknowledgments are due to the many drillers and gas and oil producers throughout Ontario, who have so kindly assisted in the preparation of this report, more especially to Mr. Jas. Kerr, Secretary Oil Exchange, Petrolea; E. Coste, Manager Provl. Nat. Gas Co., Buffalo; D. A. Coste, Buffalo; J. C. McRae, Port Colborne; J. S. Hyland, Walkerville; Peter McEwen, Goderich; M. J. Woodward, Major Savage, Wm. Harris, Jas. McCort and E. Rawlings, of Petrolea.

## PART I.

### BRIEF EXTRACTS FROM WRITINGS REGARDING THE ORIGIN OF THE HYI CARBONS, MORE ESPECIALLY PETROLEUM AND NATURAL GAS.

### *Theories of Inorganic Origin.*

**Theories of inorganic origin.**

**M. Berthelot.**

Among the principal writers on the theories coming directly ur this heading may be mentioned M. Berthelot, and later, M. M deljeff. In December, 1886, M. Berthelot published a paper* whe he says :—

"If in accordance with an hypothesis recently announced by Daubré, it is to be admitted, that the terrestrial mass contains free al metals in its interior, this hypothesis alone, together with experim that I have lately published, furnishes almost of necessity a metho explaining the formation of carbides of hydrogen. According to experiments, when carbonic acid, which everywhere infiltrates the restrial crust, comes in contact with the alkali metals at a high t perature, acetylides are formed. These same acetylides also result f contact of the earthy carbonates with the alkali metals even belo dull-red heat.

"Now, the alkaline acetylides thus produced could be subjecte the action of vapour of water; free acetyline would result if the prod were removed immediately from the influence of heat and of hydrc (produced at the same time by the reaction of water upon the metals) and the other bodies which are found present. But in co quence of the different conditions the acetyline would not exist, as been proved by my recent experiments.

"In its place we obtain either the products of its condensat which approach the bitumens and tars, or the products of the reac of hydrogen upon those bodies already condensed ; that is to say, n hydrogenated carbides. For example, hydrogen reacting upon acetyline, engenders ethylene and hydride of ethylene. A new reac of the hydrogen either upon the polymeres of acetyline or upon tl of ethylene would engender formenic carbides, the same as those wl constitute American petroleum. An almost unlimited diversity in reaction is here possible, according to the temperature and the bo present.

"We can thus imagine the production by a purely mineral met of all the natural carbides. The intervention of heat, of water, the alkali metals, together with the tendency of the carbides to u with each other to form matters more condensed, are sufficient

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*"*Les Annales de Chimie et de Physique.*"

account for the formation of these curious compounds. Their formation could thus be effected in a continuous manner, because the reactions which give birth to them are continually renewed. This hypothesis is susceptible of further development, but I prefer to dwell within the limits authorized by my experiments without wishing to announce other than geological possibilities."

M. H. Byassan.

In 1871 M. H. Byassan, in a paper read before the French Academy, on the origin of petroleum, states that "by causing carbonic acid and water to react under very simple conditions, (he) obtained a small quantity of an inflammable liquid nearly indifferent to sulphuric acid, and with an odour analogous to that of carbides of petroleum."

M. Mendeljeff.

In 1877 M. Mendeljeff read a paper before the Chemical Society of St. Petersburg, wherein he puts forth views very similar to those of M. Berthelot. A résumé of his paper was, in the same year, published,* from which the following is an extract:—"These reflections have led the author to the supposition that petroleum is in no place of organic origin. In speaking of the hypothesis of La Place upon the origin of the earth, in applying Dalton's law to the gaseous state in which all the elements constituting the terrestrial globe ought to be found, and taking into consideration their relative densities, M. Mendeljeff recognizes the necessity of admitting a condensation of metals at the centre of the earth. Among these it is natural to presume iron would predominate, because it is found in great abundance in the sun, in meteorites and basalts. Admitting further the existence of metallic carbides, it is easy to find an explanation not only for the origin of petroleum, but also for the manner of its appearance in the places where the terrestrial strata, at the time of their elevation into mountain chains, ought to be filled with crevices to their centre. These crevices have admitted water to the metallic carbides. The action of water upon the metallic carbides at an elevated temperature and under a high pressure has generated metallic oxides and saturated hydrocarbons, which, being transported by aqueous vapour, have reached those strata where they would easily condense and impregnate beds of sandstone, which have the property of imbibing great quantities of mineral oil.

"This explanation of the origin of petroleum finds support from the following facts: The predominance at the surface of the earth of elements having a small atomic weight; the appearance of petroleum in directions corresponding to great circles; the relation remarked by several naturalists, particularly by M. Abich, between petroleum and volcanic manifestations.

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*"*Bulletin de la Société Chimique de Paris.*"

"In order to make this question clear, it is indispensable to stu the different transformations of petroleum, its decomposition ir marsh-gas and non-saturated hydrocarbons; of determining the chemi nature of mineral oils of different origin; also that of the saline wa that ordinarily accompanies petroleum. Researches of this kind, connection with profound geological studies, can alone render justice the hypothesis stated above."

Other writers.

Following closely upon these statements of research and opini may be mentioned the investigations of Messrs. Friedel and Cra Clœz, Landolph, Coquand, Grabrowski and others, all of whose exp ments show rather the possibilities than the probabilities regarding origin of hydrocarbons.

Prof. R. C. Taylor.

Prof. R. C. Taylor,* while not expressing himself regarding origin of petroleum, cites many instances wherein oil occurs intimat connected with rocks of eruptive or highly metamorphosed charac Of the Island of Havana, he writes: "Petroleum leaks out in num less places in this delightful island from amid the fissures of the serp tine, and perhaps has deep-seated sources."

Tar Point, Gaspé.

The occurrence of petroleum, in the amygdules of a trap dyke Tar Point, Gaspé, is mentioned as follows:*—"This dyke, wh does not occur in the centre of the fold, but about 200 ya to its north-east or precipitous side, has a breadth of ten twelve yards, with a direction N. 83° W. Its colour is dark gr weathering to a rusty red, and it is traversed by numerous ho zontal and vertical joints, and abounds in large and small drus which, as well as the joints, are often lined with chalcedony; sometin in the case of the druses, presenting botryoidal surfaces, and at oth encrusted with crystals of quartz and calcite. These cavities as as others which are not thus lined with chalcedony, are filled petroleum; this, in some instances, has hardened to the consistency pitch."

S. F. Peckham's review of Berthelot's theory.

Mr. S. F. Peckham reviewing the theory advanced by M. Berthel writes: †"The theory of M. Berthelot appears to me to derive support from observed facts than any which has been propos It was doubtless formed with reference to the petroleums of Per sylvania, which are among the purest mineral hydrocarbons of a found in large quantities. The very small proportion of nitrogen existi in these oils might perhaps be accounted for as an accidental constitue of the limestone, or as being mechanically mingled with the water vapour. Neither supposition is at all probable, since nitrogen posses such slight affinities. It adds nothing to its support to admit that the alkali metals do exist in the interior of the earth in the free state. The very great difference observed between the varieties of the petroleum cannot be explained upon any hypothesis that regards them as the results of the same process acting upon light materials ; neither should it be expected that a process yielding an almost 'unlimited diversity' of products, under slightly varying circumstances, would furnish a uniform result over a very wide area. Samples of Pennsylvania petroleum of the same density, when gathered from widely separated localities, furnish identical results upon analysis; so, too, do California petroleums, though gathered from localities fifty miles apart ; and yet the two varieties of oil are exceedingly unlike. 'It is, moreover, altogether erroneous to attempt to explain the causes of geological facts by the aid of supposed analogies with the complex apparatus of physical cabinets, whose existence in nature could scarcely be conceived by the boldest and most unrestrained imagination.'" (*a*).

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*"Statistics of Coal," Philadelphia, 1885.

*Geology of Canada, 1863, p. 402.

†Proceedings of the American Philosophical Society, vol. X., 1867, pp. 455.

## *Theories of Organic Origin.*

Theories of organic origin

The organic origin of hydrocarbons is at the present time conceded by the majority of geologists and chemists, but an inorganic origin may, perhaps, be admitted in certain exceptional cases.

Theories under the above heading must again be divided; many adhering to the opinion that hydrocarbons are the result of (1) the primary distillation of vegetable or animal remains, while others contend that they are the products of (2) a secondary distillation or decomposition of organic remains made at some period subsequent to their deposition.

Dr. Ed. Orton.

Dr. E. Orton,* thus defines these different opinions : "The first view is, that petroleum is in large part derived from the *primary decomposition of organic matter* that was stored in, or associated with, the strata that now contain it. According to this view, the decomposition was mainly effected *in situ*, and the product resulting is, therefore, mainly indigenous to the rock in which it is found. The last feature is seized upon in most popular statements, and a *theory of indigenous origin* is made to include most beliefs of this class. It must be borne in mind, however, that no author is to be found who holds strictly and consistently to such indigenous origin, but the name can still be used as a general designation without harm."

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(*a*) Quotation from Bischof : "Chemical and Physical Geology."

* Geological Survey of Ohio, vol. VI.

"The second view is, that petroleum is derived from the *secondai decomposition of organic matter* stored in the rocks. It supposes tl original vegetable and animal matter to have suffered a partial trai formation and to be now held in the rocks as hydrocarbon compounc from which, *by a process of distillation*, oil and gas are derived. T so-called bituminous shales are counted the chief sources of these pı ducts. After distillation it is held that the gas and oil are main carried upward by hydrostatic pressure to some overlying poro stratum that serves as a reservoir. This class can be convenient grouped under the name of the distillation theory."

*Theory of Origin by Primary Decomposition.—Hunt's Theory.*

Theory of primary distillation.—Hunt's theory.

Among the most prominent exponents of the former or indigeno theory may be mentioned Dr. T. Sterry Hunt, who, in a long series articles on the subject, endeavours to prove that gas and oil are, wi few exceptions, indigenous to limestones alone, though also fouı adventitiously in sandstones, shales, and conglomerates. Among t most important producing strata he includes the limestones of tl Trenton and Corniferous formations.

He writes: [*] "The fact that intermediate porous strata of simil mineral character are destitute of bitumen, shows that this materi cannot have been derived from overlying or underlying beds, but h been generated by the transformation of organic matters in the stra in which it is met with."

And again: [†] "It has already been shown that the petroleum Canada occurs in two district horizons; the one in the limestones of tl Trenton group, and the other in those of the Corniferous formatio To this it must now be added, that the petroleum of Gaspé probab belongs to an intermediate position, and is to be referred to limeston of Upper Silurian age."

Also: [‡] "In opposition to the generally received view, which su poses the oil to originate from a slow destructive distillation of tl black pyroschists, belonging to the middle and upper Devonian, have maintained that it exists, *ready formed*, in the limestones below

He writes: [§] "Concretionary nodules holding petroleum ha also been observed in the Marcellus and Genesee slates, while tl higher Devonian sandstones in New York and Pennsylvania are oft impregnated with petroleum, and from these, and from still high strata, issue the oil springs of those regions. It is probable, however, that the source of the oil in these superior strata is to be found in the Corniferous limestone, from which the petroleum of Western Canada is undoubtedly derived. * * * In the township of Rainham, on Lake Erie, the shells of *Pentamerus aratus* are sometimes found to have an inner cavity, lined with crystals of calcite, and filled with petroleum. Coralline beds impregnated with petroleum are found in Wainfleet and in Walpole, in the latter instance immediately beneath a layer of chert, but I have more particularly examined them in the township of Bertie, which is on the Niagara River, opposite Buffalo. Here, in a quarry are seen massive beds, slightly inclined, composed of a solid crystalline encrinal limestone, which appears not only destitute of petroleum, but from the water, by which it is impregnated, to be impermeable to it. In some of these beds are large corals of the genus *Heliophyllum*, the pores of which are open, but contain no oil. Two beds, however, one of three, and one of eight inches, which are interstratified with these, are in great part made up of species of *Heliophyllum* and *Favosites*, the cells of which are full of petroleum. This is seen, in freshly broken masses, to be absent from the solid limestone, which forms the matrix of the corals, and resembles in texture the associated beds. As the fractured surfaces of the oil-bearing beds become dry, the oil spreads over them, and thus gives rise to the appearance of a continuous band of dark oil-stained rock, limited above and below by the lighter limestone, from which, however, it is separated by no planes of bedding. The layer of three inches was seen to be twice interrupted in an exposure of a few feet, thus presenting lenticular beds of the oil-bearing rock. Besides the occasional specimens of *Heliophyllum* without oil, disseminated in the massive limestone, a thin and continuous bed of *Favosites* is met with, which is white, porous, and free from oil, although beds both above and below are filled with it. * * * The facts observed at this locality appear to show that the petroleum, or the substance which has given rise to it, was deposited in the beds in which it is now found, at the formation of the rock. We may suppose in these oil-bearing beds an accumulation of organic matters, whose decomposition in the midst of a marine calcareous deposit, has resulted in their complete transformation into petroleum, which has found a lodgment in the cavities of the shells and corals immediately near. Its absence from the unfilled cells of corals in the adjacent and interstratified beds, forbids the idea of the introduction of the oil into these strata either by distillation or by infiltration. The same observations apply to the petroleum of the Trenton limestone, and if it shall hereafter be shown that the source of petroleum (as distinguished from asphalt) in other regions, is to found in marine fossiliferous limestones, a step will have been ma towards a knowledge of the chemical conditions necessary to its forn tion. * * * It would appear that the Devonian sandstones Pennsylvania and North-eastern Ohio are filled with oil, which l risen from the limestone beneath, while, over a great portion Western Canada, this limestone was ages ago denuded, and has l the greater part of its petroleum."

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[*] Canadian Naturalist, Vol. VI., p. 242.

[†] Geology of Canada, 1863, p. 786.

[‡] American Journal of Science, Vol. XLVI., 1868, p. 360.

[§] American Journal of Science, Vol. XXXV., 1863, p. 167, 168.

**Chicago limestone.**

Again, in writing of a dolomite of the Niagara formation, m with near Chicago, Illinois ("Chicago limestone"), he again ve plainly states his views, as follows :—"A layer of this oleifer dolomite, one mile square and one foot thick, will contain 1,184,8 cubic feet of petroleum, equal to 8,850,069 gallons of 231 cu inches, and to 221,247 barrels of 40 gallons each. Taking t minimum thickness of 35 feet assigned by Mr. Worthen to the bearing rock at Chicago, we have in each square mile of it 7,743,7 barrels, or in round numbers, 7,750,000 barrels of petroleu

* * * * With such resources existing ready formed in t earth's crust, it seems to me, to say the least, unphilosophical to sear elsewhere for the origin of petroleum, and to suppose it to be deriv by some unexplained process from rocks which are destitute of t substance."

**Other writers on theory of primary distillation.**

In Dr. Hunt's voluminous writings on the subject, much more m be found showing him to have been consistent in his assertions, b the above extracts have been thought sufficient to illustrate t views held by him. Similar opinions are held by many other America and European geologists, among whom may be mentioned Messr Stafford, Lesley, Binney, Aiken, Bright, Prestwich, Winchell, Whit Whitney, Jones and Wall.

The last named writes*:

**Wall on Trinidad asphalt.**

"The asphalt of Trinidad is almost invariably disseminated in th upper group of the "Newer Parian." When *in situ* it is confined t particular strata, which were originally shales containing a certai proportion of vegetable *debris*. The organic matter has undergone special mineralization, producing bituminous in place of the ordinar anthraciferous substances. This operation is not attributable to heat nor of the nature of distillation, but is due to chemical reaction at th ordinary temperature and under the ordinary conditions of th climate. The proofs that this is the true mode of generation of th asphalt repose not only on the partial manner in which it is distribute in the strata, but also on numerous specimens of the vegetable matter in process of transformation and with the organic structure more or less obliterated. After the removal, by solution, of the bituminous material, under the microscope a remarkable alteration and corrosion of the vegetable cells becomes apparent, which is not presented in any other form of the mineralization of wood. A peculiarity attending the formation of the asphalt results from the assumption of a plastic condition, to which property its frequent delivery at the surface is partly referable. * * * * Sometimes the emission is in the form of a dense oily liquid, from which the volatile elements gradually evaporate, leaving a solid residue. * * * * The phenomenon of salses or mud-volcanoes, consisting of the solution of inflammable gas, accompanied by the discharge of a muddy fluid and asphaltic oil, is perhaps closely related to the activity just described, as carburetted hydrogen may be disengaged in the direct formation of asphalt."

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* "Geology of a part of Venezuela and Trinidad." Q.J.G.S., Vol. XV p. 467.

## *Theory of Origin by Secondary Decomposition or Distillation.*

Theory of secondary decomposition or distillation.

Among those intimately connected with the second or distillation theory are Messrs. J. S. Newberry and S. F. Peckham, both of whom advance somewhat different opinions, acknowledging, however, the great principle of a secondary distillation of organic remains stored in the rocks of the earth's crust. The former contends that the distillation is continuous and at a low temperature, while the latter equally strongly maintains it to be the result of distillation accomplished of a necessity by heat; citing as an example of this, the oil and gas of Pennsylvania, whose origin he accounts for by distillation through the agency of heat generated during the elevation of the Appalachian Mountains.

Newberry's theory.

*J. S. Newberry's Theory.*—In 1859, in a paper on the "Rock Oils of Ohio*," Newberry states his views very distinctly in the following words: "The precise process by which petroleum is evolved from the carbonaceous matter contained in the rocks which furnish it is not yet fully known, because we cannot in ordinary circumstances inspect it. We may safely infer, however, that it is a distillation, though generally performed at a low temperature. * * * * * When, however, carbonaceous organic tissue is buried in moist earth or submerged in water, oxidation does not at once ensue, or at least takes place to a limited extent, measured by the amount of oxygen present. In these circumstances bituminization takes place. This pro-

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* "Ohio Agricultural Report," 1859.

cess consists mainly in the union of hydrogen, from the tissue its
its surroundings, with a portion of the carbon, to form carbu
hydrogen, which perhaps escapes, and the hydrocarbons constit
the bitumen, which usually remains as a black, pitch-like ma
vesting the fixed carbon. By this process peat, lignite, and co
formed, which are solids, and doubtless some liquid and gaseous h
carbons which escape. Now, when we heat these solid bitumen
ficially at a sufficiently high temperature, if in contact with ox
combustion ensues, and water and carbonic acid are formed from
At a lower temperature they are converted into gaseous hydrocar
still lower, to oils."

Again he says*: "The origin of the two hydrocarbons i
same, and they are evolved simultaneously by the sponta
distillation of carbonaceous rocks. * * * *
* * * * Where the oil and gas-producing r
and those overlying them, are solid and compact, decomposition c
organic matter they contain takes place very slowly and the esca
the reacting hydrocarbons is almost impossible. Where they are
or less shaken up, decomposition takes place more rapidly; reser
are opened to receive the oil and gas, and fissures are proc
which serve for their escape to the surface. Near the Alleghani
the rocky strata are more or less disturbed, and here along certain
the liquid and gaseous hydrocarbons are evolved in enormous quant
As we come westward, however, we find the rocks more undistu
and the escape of oil and gas, through natural or artificial ori
gradually diminished." Again, in the same volume, page 158, he s
"We have in the Huron shale a vast depository of solid hydro-ca
aceous matter, which may be made to yield from ten to twenty ga
of oil to the ton by artificial distillation. Like all other organic m
this is constantly undergoing *spontaneous* distillation, except w
hermetically sealed deep under rock and water. This results in
formation of oil and gas, closely resembling those which we make
ficially from the same substance; the manufactured differing from
natural products only because we can not imitate accurately the
cesses of nature. * * * A line of gas and oil spr
similar to that already referred to, follows the outcrop of the Cleve
shale; a carbonaceous stratum in the overlying Waverley group,
the quantity of liquid and gaseous hydrocarbons generated here is n
less than that evolved from the Huron shale, because one is 50,
other 300 feet in thickness. Again, the emanations of oil and gas f
the Lower Silurian rocks at Collingwood, Canada, and on the u

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*Geological Survey of Ohio, Vol. I., 1873, pp. 192-193.

Cumberland River, Kentucky, are associated with similar deposits of black shale which represent the Utica slate of New York."

The foregoing extracts have been thought sufficient to illustrate Mr. Newberry's theory, which may be summarized as follows:—Oil and gas are the result of a *continuous and spontaneous distillation* of the bituminous matter of certain shales, from which the greater part of the two hydrocarbons is obtained.

He acknowledges, however, that the bitumen of the Chicago limestone is indigenous to the rocks in which it is stored. Of the Corniferous formation, he states, very distinctly,* that from the limestones of this formation but little oil has ever been obtained. This statement is evidently a mistake, as it is from wells in this limestone that the oil of Enniskillen township has been obtained for the past twenty-seven years; while efforts to find it in the underlying strata have not proved successful, though test-wells have been sunk at several points in both the Petrolea and Oil Springs fields.

Peckham's theory.

*S. F. Peckham's Theory.*—The following extracts from S. F. Peckham's report on Petroleum† have been made with the intention of placing before the reader this gentleman's view regarding the origin of hydrocarbons. That his statements are to a certain extent contradictory, or in need of further explanation, is evident. He writes in the above-mentioned report:

> "It is not the effects of heat, as represented by volcanic action, that have produced petroleum * * * Bitumens are not the product of the high temperatures and violent action of volcanoes, but of the slow and gentle changes at low temperature due to metamorphic action upon strata buried at immense depths. * * * The alteration, due to the combined action of heat, steam and pressure, that involved the formations of the Appalachian system from Point Gaspé, in Canada, to Lookout Mountain, in Tennessee, involving the Carboniferous and earlier strata, distorting and folding them, and converting the coal into anthracite and the clays into crystalline schists along their eastern border, could not have ceased to act westward along an arbitrary line, but must have gradually died out farther and farther from the surface."
>
> "The great beds of shale and limestone containing fucoids, animal remains, and even indigenous petroleum, must have been invaded by this heat to a greater or less degree, and that 'chronic evaporation' of Prof. Lesley must have been the inevitable consequence."

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* Geological Survey of Ohio, Vol. I.

† "Tenth census of the United States." Vol. X.

"Too little is known about petroleum at this time to enable any o to explain all the phenomena attending the occurrence of petroleu on any hypothesis; but it seems to me that the different varieties petroleum, from Franklyn dark oil, near the surface, to Bradford a Clarendon amber oil, far beneath the surface, are the products fractional distillation, and one of the strongest proofs of t hypothesis is found in the large content of paraffine in the Bradfo oil under the enormous pressure to which it is subjected."

"The fact that the eruptive rocks of Lake Superior and the me morphic rocks farther east prevail to such an extent that that va inland sea has been supposed to be the crater of an extinct volca lake lends the strongest support to an hypothesis that regards the va accumulations of petroleum in western Canada as due to the invasi of strata on the borders of this heat-centre, in which the petroleu is indigenous, by a sufficiently elevated temperature to cause i distillation."

"It appears to me that mud volcanoes and hot springs are prope regarded as the phenomena attending the gradual subsidence metamorphic action in the crust of a cooling earth, and that petrole or maltha is but the accident of such phenomena, when strata taining organic matter are still invaded at a great depth by a temp ture sufficient to effect the distillation of their organic content."

Prof. J D. Dana.

The explanation of the origin of petroleum given by Prof. J. Dana* adds considerable weight to the evidence adduced in support the theory of secondary decomposition or distillation. He says:

"The conditions favourable to the formation of naphtha, as sho by the characteristics of the deposits in which it is found native, the following: (1) The diffusion of organic material through a f mud or clay; (2) the material in a very finely divided state; and as a consequence of the preceding, the atmosphere excluded as far possible from the material undergoing decomposition. There is reas to believe that no more heat was required than what was afforded the natural climate or temperature of the region and the process fermentation."

"Shales, the most common oil-bearing rocks, were originally t fine mud of deep or shallow seas; and the limestones were the sa only the mud was calcareous in nature, like the coral mud of man coral lagoon, as the author has elsewhere described, after perso examination. These shales ordinarily contain few fossils of any ki and very rarely distinct vegetable remains. It may be questio whether tough fucoids (sea-weeds), or the branches and leaves of ordinary plants imbedded in such clays, would ever become so subdivided or disorganized as to make the requisite emulsion with the mud free from any vegetable forms; and it is more probable that the vegetable material present was either delicate water-plants or was derived from abundant infusorial or microscopic vegetable life. The limestones, on the contrary, are sometimes full of fossils, but these are animals; and, as the solid parts which make the fossils are to a large extent ground up to make the mud that becomes the limestone, the organic material these hard parts contain, as well as that of the fleshy parts and oils, would be diffused through the mud or earth in the very condition demanded.

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*"System of Mineralogy," 5th edition, page 725.

"The light native oils do not occur in coal beds, which were made from thick beds of vegetable debris.

"In the above-mentioned circumstances, with the deposits under pressure from superincumbent beds, the atmospheric air almost totally excluded, the organic material might undergo decomposition through the reactions of its own elements alone."

## PART II.

### RECORD OF BORING OPERATIONS AND NOTES ON THE DISTRIBUTION OF NATURAL GAS AND PETROLEUM IN ONTARIO, UP TO THE CLOSE OF THE YEAR 1890.

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### WELLS IN EASTERN ONTARIO.

#### *Well near Bainsville, Glengarry County.*

Throughout that part of Ontario, east of Whitby on Lake Ontario, and Pembroke on the Ottawa River, several wells have been fruitlessly sunk for gas or oil. Bainsville.

The most easterly of these borings was made near Bainsville during the years 1865 and 1866, on lot 21, concession 2, Lancaster township, Glengarry county. It was sunk to a depth of 500 feet in search of oil and was unsuccessful, though small flows of gas were said to have been met with. The surface deposits, thirty feet thick, consisted of clays and sands overlying a gravel bed from which a copious flow of very pure, fresh water was obtained. I am indebted for information regarding the well to Mr. Alex. Campbell, of Bainsville, who was, unfortunately, unable to supply data regarding the rocks encountered; it is, however, presumed that they consisted chiefly of limestones of the Trenton formation.

### *Wells at Caledonia Springs, Prescott County.*

**Caledonia Springs.**

Since 1805 gas has been known to occur in the mineral springs of this neighbourhood, though no deep borings have as yet been made in quest of it. In connection with "The Grand Hotel" (Sanitarium) are several springs from which the mineral water used in the hotel is obtained. These springs have been opened up and the water is now taken from tanks into which it constantly flows. One of these, known as the "Gas Spring," is seen to be in a constant state of ebullition caused by the escape of gas.

Dr. Sterry Hunt describes this spring as follows*:—"One of these is known as the Gas Spring, from the quantity of carburetted hydrogen gas which it evolves, and which is roughly estimated at 300 cubic inches per minute." About 3,000 cubic feet per diem.

No search has yet been made in the neighbourhood for larger quantities of gas, though several drive wells have been sunk, in a number o which gas has been observed. The surface deposits are about 10 feet thick, resting immediately on the Trenton limestone.

### *Well at Ottawa, Carleton County.*

**Ottawa.**

During 1888 two companies applied for the franchise from the city of Ottawa to lay pipes to transport natural gas for lighting and other purposes. The claims of the rival companies were vigorously upheld till the spring of the following year, when the controversy was finally settled by the action of the Premier Gas Co., which in May, 1889, commenced boring operations on the north side of Patterson's Creek near the southern limit of the city. In April, 1890, the company, after many reverses, had succeeded in sinking a well 1,005 feet deep; but neither gas nor oil having been obtained the work was then suspended. It is said that oil in small quantities was observed at 900 feet. Sulphurous water was struck at 320 feet and salt water in grea quantity at 550 feet. Casing was carried to a depth of 820 feet, though, owing to some defect, the water was never effectually shut off but rose to the surface and flowed over in a weak stream.

No very accurate record of the boring was kept, and but fe specimens were obtained, those available being as follows:—

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* Geology of Canada, 1863, p. 535.

Specimen from 30 feet—Limestone, light blue.
" " 35 " " shaly, dark blue.
" " 82 and 110 feet—Limestone, light blue.
" " 120, 140 and 150 feet—Limestone, shaly, dark blue.
" " 160, 180 and 185 " " light blue.
" " 190 feet—Limestone, soft, shaly (thin laminæ) arenaceous.
Specimen from 195 to 220 feet—Limestone, light grey.
" " 225 feet—Limestone, dark blue.
" " 230 " " light grey.
" " 240 " " " " with chert.
" " 250 " " " "

Between 250 and 310 feet a streak of sandstone similar to that at 310 feet is said to have been traversed, though of what thickness is unknown.

Specimen from 310 feet—Sandstone, fine grained, highly calcareous.
" " 315 " Limestone, with pyrite and fragments of *Leptæna sericea* and *Orthis*, sp.
Specimen from 335 feet—Limestone.
" " 350 " " dark blue, with pyrite and *Orthis*, sp.
Specimen from 380 feet—Limestone, blue, with quartz.
" " 475 " " light blue, with pyrite in abundance.

Below this point, it is said that nothing but light blue limestone was found, which may possibly be of the Black River formation.*

### *Well at North Gower—Carleton County.*

North Gower

Some twenty years ago an unsuccessful attempt was made to obtain oil near this village. No data are at hand regarding this well, beyond the fact that neither gas nor oil was found.

### *Well near Pembroke—Renfrew County.*

Pembroke.

During the summer of 1888, a well was sunk some four miles west of Pembroke, in the township of McKay. The enterprise was unsuccessful, however, neither gas nor oil being obtained. No information is at hand regarding this boring, the precise position of which is uncertain, as the township has not yet been surveyed.

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NOTE.—I informed persons connected with the undertaking, before operations were commenced, that there was no probability of their getting either petroleum or natural gas, but almost certainly saline water.—A. R. C. SELWYN.

### *Well at Deseronto—Hastings County.*

**Deseronto.**

While drilling in the yard of the hotel owned by W. Jamieson, Esq of Deseronto, gas in small quantities was found in the limestone at depth of thirty feet; the well is only sixty feet deep. At fifteen fee the thickness of the surface deposits, there was a strong odour of ga and from the lower thirty feet a sufficient quantity was obtained support a small flame at the mouth of the casing.

### *Well at Whitby—Ontario County.*

**Whitby.**

A well was sunk in 1888 in the town of Whitby by a company co posed of citizens of that place under the title of "The Whitby Gas an Water Company," with a capital stock of $10,000. The boring w made on lot 28, 7th double range, west of Brock street, and w carried to a depth of 728 feet as follows:—

| | | |
|---|---|---|
| Surface | 50 feet. | |
| Shale | 70 " | Utica. |
| Limestone | 600 " | Trenton. |
| "Arkose" beds | 8 " | to granite. |

Small quantities of gas were found at 400 and 700 feet. At t time of my visit the well was flooded to the top of the casing a it was found impossible to get an accurate measurement of the flow it is, however, safe to estimate it as being under 2,000 cubic feet p diem.

## WELLS IN YORK COUNTY.

### *Well at Highland Creek.*

**Highland Creek.**

I have been unable to obtain any authentic account of operations this point, and give the following as the result of inquiries made different times and of various persons. The information obtaine shows that a well was sunk near this village, during either 1866 1867, to a depth of 682 feet, penetrating the Trenton limestone to depth of 434 feet, in which formation it is reported that large quantiti of gas were struck.

The record of the well is reported as follows:—

| | | |
|---|---|---|
| Surface (blue clay) | 48 feet. | |
| Shale (black) | 200 " | Hudson River and Utica. |
| Limestone | 434 " | Trenton. |

The fact that the well was at once abandoned shows that the was, as is usual in this district, but a small flow of gas.

### *Well at Copland's Brewery, Toronto.*

Toronto.

In 1882 a well was sunk for water in the yard at Copland's brewery on Parliament street, Toronto, where, at a depth of 1,200 feet, granite was struck. No good water was found.

The record is as follows:—

| | | | |
|---|---|---|---|
| Surface | 40 | feet. | |
| Limestone | 150 | " | Hudson River. |
| Shale | 405 | " | Hudson River and Utica. |
| Limestone | 585 | " | Trenton. |
| "Arkose" beds | 20 | " | to granite. |

The driller, Mr. W. Harris, of Petrolea, reports that neither gas nor oil was found.

### *Well at Ontario Bolt Works, Swansea, Toronto.*

Swansea.

An unsuccessful attempt to obtain gas was made during 1888, or 1889, on the east side of the Humber River, about three-quarters of a mile from the lake shore, and about the same distance north of the bolt works. The well, sunk by the Ontario Bolt Company, reached a depth of 703 feet; sixty feet below the summit of the Trenton limestone. During the winter of 1890-91 this well was continued to a total depth of 1,261 feet, or 16 feet into the Archean rocks, the drillings showing these to consist of crystalline limestone with mica, pyrite and a serpentinous mineral. Throughout the first 700 feet considerable flows of saline and other mineral waters were noted; neither gas nor oil was found.

The record shows the following section:—

| | | | |
|---|---|---|---|
| Sand | 65 | feet | Surface deposit, 107 feet. |
| Quicksand | 15 | " | |
| Hardpan | 27 | " | |
| Grey shale | 440 | " | Hudson River and Utica. |
| Black " | 40 | " | |
| Grey " | 56 | " | |
| Limestone | 107 | " | Trenton. |
| Soapstone | 5 | " | |
| Limestone | 480 | " | |
| Fossil rock | 10 | " | |
| Crystalline rocks | 16 | " | Archæan. |

Elevation above tide, 347 feet.

Several other wells have been sunk to and into the Trenton limestone in and around Toronto, from none of which has gas been reported, though it is known to occur in small quantities about eight miles west, and at Highland Creek, about fifteen miles east of Toronto.

### *Well at Mimico.*

Mimico.

During the summer of 1889, a well was sunk by the Ontario Government at Mimico, a village some eight miles west of Toronto. The well, begun in search of water, was carried as an eight-foot shaft to a depth of fifty feet, or forty-three feet into the blue shaly limestones of the Hudson River formation. A four-inch boring was then begun, in anticipation of finding gas. It reached a total depth of 1,060 feet, only small quantities of gas being obtained at the depths of 425, 575 and 1,052 feet. A flow of water was struck at twenty-five feet, but too small, however, to be of economic importance; the well was then cased to a depth of 100 feet, beneath which point it was quite dry. The record, according to the driller, is as follows :—

| | | |
|---|---|---|
| Surface ........ | 7 feet. | |
| Blue shale...... | 493 " | Hudson River and Utica. |
| Brown " ...... | 223 " | |
| Limestone ...... | 337 " | Trenton. |

## WELLS IN SIMCOE COUNTY.

### *Wells at and around Collingwood.*

Collingwood.

At Collingwood the Trenton limestones outcrop and constitute t entire series of measures through which the various wells were su the total thickness being in the neighbourhood of 600 feet; these roc are to the south capped by Utica shale, which forms the base of t Blue Mountains, a range of hills lying to the south-west of the to The limestones on the shore and throughout the town show little no dip, though on approaching the Blue Mountains they have a slig dip to the S.S.W. The Utica shales, at a point a few miles west Collingwood, cover the Trenton and further west are succeeded in tu by the Hudson River and Clinton formations.

*No. 1 Well.*—This well, on lot 16, west side of Peel street, w bored during the spring of 1888, to a depth of 553 feet, at whi point granite was reached immediately underlying the limeston which was 543 feet thick, under ten feet of surface deposits. Gas w struck in small quantities at 140 and 160 feet from the surface, b on being torpedoed the well rapidly filled with water. This inflo was ineffectually contended with and the well finally abandoned.

*No. 2 Well.*—This well is also within the town site on lot 21, ea side of Oak street. It is 542 feet deep; soil two feet, Trenton li stone, 540 feet. Gas was struck at 160 feet, having a daily flow 4,000 cubic feet. Two dwelling-houses, those of Messrs. Carpenter a Stewart, were at the time of my visit being lit and partly heated by The well was practically free from water.

*No. 3 Well.*—About half a mile to the south-east of No. 2 a well was sunk to a depth of 464 feet, penetrating the Trenton limestone to the depth of 460 feet and affording but a small quantity of gas, which was struck at 175 feet. Like No. 2 it was almost entirely free from water.

The above-mentioned three wells were sunk at the expense of a syndicate of residents for the purpose of obtaining gas to illuminate the streets. They were sunk at but small cost, there being no casing necessary.

*Well at McDonell's Mill.*—In the rear of the Hurontario flouring mill, in the eastern part of Collingwood, Mr. Charles McDonell, the owner, bored for gas in the Trenton limestone, to a depth of 351 feet; at 150 feet, a small quantity of gas, about 2,000 cubic feet per diem, was obtained.

### *Oil Shale near Collingwood.*

Oil shale and works near Collingwood.

It may not be amiss to mention here the shale distilling works at one time in successful operation near Collingwood, the ruins of which may still be seen near the road a few miles to the west of the town. On lot 23, concession 3, township of Collingwood, Grey county, there is an exposure of Utica shales, consisting of a bed of pyro-schists of about seven feet in thickness, which afforded some three per cent of crude oil. Dr. Sterry Hunt, writes in the following terms of the enterprise: *

"This rock is highly calcareous, containing more than one-half its weight of carbonate of lime. When ignited in a closed vessel it loses 12·4 per cent of volatile and combustible matter; of which from three to four per cent are condensable into an oily liquid. This, when rectified, yields oils fitted for burning and for lubricating purposes, and probably also a portion of paraffine.

"In 1859, works for obtaining these oils were erected on the locality of this shale, near the town of Collingwood. Twenty-four longitudinal cast-iron retorts were set in two ranges and heated by means of wood, of which twenty-five cords are said to have been required weekly. The shale, broken into small fragments, was heated for two or three hours, from eight to ten charges being distilled in twenty-four hours. In this way, it is said, from thirty to thirty-six tons of shale were distilled daily, and made to yield 250 gallons crude oil, corresponding to about three per cent of the rock. By further continuance of the heat, a small additional proportion of oil was obtained from the rock; but it was found more economical to wi draw the charge after two hours and a half. The bed of shale av able for the purpose adjoins the works, and was furnished, rea broken, at twenty cents the ton. The cost of the crude oil from shale was stated by the manufacturers to be fourteen cents the gall When rectified and deodorized, it gave from 40 to 50 per cent burning oil, and from 20 to 25 per cent of pitch and waste, remainder being a heavy oil fitted for lubricating purposes. After t or three unsuccessful trials, and the repeated destruction of the wor by fire, they were at last, in 1860, got into successful operation, and ready market was found for the oils."

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* Geology of Canada, 1863, pp. 784-85.

### *Well at Orillia.*

Orillia.

An ineffectual attempt was made, some years ago in Orillia, obtain water by means of an artesian well. At a depth of 300 fe granite was struck and operations ceased; the surface deposi measured 170 feet, the remaining 130 feet being in the Trenton lim stone. No gas was encountered in this well and but small quantiti of water.

### *Wells in Barrie.*

Barrie.

Numerous "drive" wells have been sunk in this town, in all which an abundance of fresh water has been found; it rises to a heig of about twenty feet above the level of Lake Simcoe. These wells ha an average depth of 250 feet, the deepest being 276 feet; in none of th has gas been noticed.

### *Wells at Beeton.*

Beeton.

In either 1882 or 1883, "The Lilley Well" was sunk, in th northern part of the village of Beeton, to a depth of 1,400 feet, which but a very imperfect log has been obtained; it is presume however, that the drilling pierced the Trenton limestone.

Considerable quantities of gas were obtained from a soft sand roc at the base of the surface deposits, and smaller quantities througho the rock to a total depth of 500 feet, none being found, howeve below that point. The well was cased into the harder rock, th shutting off the larger flow of gas; no water was struck till near t bottom of the boring where there was a small flow of salt wat probably from the Trenton.

The well was ultimately plugged and abandoned.

The log as reported by the driller is as follows :—

| | | | |
|---|---|---|---|
| Surface.......... | 321 | feet. | |
| Soft sand-rock .... | 25 | " | "Medina," from which was greatest flow of gas. |
| Limestone........ | 850 | " | |
| Shale............ | 204 | " | Probably Utica and lower part of Hudson River. |

### *Gas at Beeton.*

For many years gas has been known to exist, in and around Beeton, though no well-directed efforts have as yet been made to obtain it beyond the sinking of several drive-wells, which in every instance showed the existence of a more or less useful flow of gas. One, known as "Jones's Well," was sunk in Jones's brickyard adjoining the railway station to a depth of 190 feet, where a bed of gravel, three feet thick, was found immediately overlying the rock. In this well the flow of gas was so great as to blow the pipe out of the hole, rendering the well practically useless. The flow has for some years been unremitting, boiling up through a pool of water, where being ignited, the gas burns fiercely.

In many places throughout the neighbourhood, water-wells sunk in the surface clay, to even a small depth, have been rendered useless by the influx of carburetted hydrogen gas.

## WELLS IN GREY COUNTY.

### *Well at Delphi.*

Dephi

During the month of July, 1888, a well was sunk at this place on lot 5, concession 26, Collingwood township, about six miles west of Collingwood and close to the shore of Georgian Bay. The boring was commenced in the Utica shales, which immediately underlie the drift deposits, and continued to a depth of 587 feet or 539 feet into the Trenton limestone, the record being as follow :—

| | | | |
|---|---|---|---|
| Surface, red clay.................. | 8 | feet. | |
| Black shale...................... | 40 | " | Utica. |
| Blue limestone .................. | 539 | " | Trenton. |

Gas was met with at a depth of 95 feet from the surface, having a daily flow of about 6,000 cubic feet; a flow considerably in advance of that of any other well in the district. It has, however, not yet been utilized, notwithstanding the fact that the well is but one hundred yards distant from Field's Hotel, a large summer resort.

### *Well at Thornbury.*

Thornbury.

A well was sunk at this place during the year 1888, of which unfortunately but few data are at hand. The facts ascertained are that a well was sunk at Andrews' mill to a depth of about 550 feet, in which was encountered a very considerable quantity of water, which was not shut off and the well was finally abandoned. A small show of gas was reported from this boring.

## WELL IN HALTON COUNTY.

### *Well near Milton.*

Milton.

The following mention by Dr. T. S. Hunt, is made of a well sunk near Milton:—

"A well near Milton, on the tenth lot of the first concession of Trafalgar, was sunk through soil, 47 feet; red shale, 200 feet, then through bluish shales, with hard layers, 159 feet, making in all 406 feet, and probably ending in the Hudson River formation."

From inquiries made in Milton it was ascertained that neither gas nor oil was noted.

## WELLS IN WENTWORTH COUNTY.

### *Well in Flamborough Township.*

Flamborough.

At some time previous to 1866, a well was sunk on lot 8, concession 8, of Flamborough East, reaching a depth of 465 feet, the boring at that depth being in the Medina formation. In a thin layer of sandstone at a depth of 340 feet from the surface, and eighty-five feet in the red shales, a small quantity of petroleum is said to have been obtained. The drilling was begun in either the base of the Guelph or summit of the Niagara formation, the whole of which, with the underlying Clinton, was probably traversed.[†]

### *Well at Insane Asylum, Hamilton.*

Hamilton.

This well, sunk some years ago at the Asylum for the Insane, south of Hamilton, is on lot 17, concession 5, township of Barton, at an elevation of about 300 feet above Lake Ontario. The bore was commenced on the Niagara limestones, and reached a depth of 1,318 feet, being then near the summit of the Utica formation.

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[*] Progress Rept. Geol. Surv. of Can., 1866, p. 252.

[†] Ibid. p. 251.

The driller's record is as follows:—

| | | | |
|---|---|---|---|
| Surface...... | 14 | feet. | |
| Limestone ... | 70 | " | Niagara and Clinton. |
| Sandstone.... | 7 | " | "Grey band" " |
| Red shale.... | 634 | " | Medina. |
| Blue " .... | 593 | " | Hudson River and Utica, with probably the lower part of the Medina. |

Neither gas nor oil was noticed in this well.

*Well in Hamilton.*

Hamilton.

A well was sunk in the yard of the Royal Hotel, Hamilton, about ,000 feet deep, of which, unfortunately, no record or information is vailable. The formations penetrated are, however, assumed to be he same as in the well at the Insane Asylum mentioned above, the difference in elevation being about 250 feet, while the rocks rise at a slight angle towards the city and from the last mentioned well.

*Well at Dundas.*

Dundas.

During 1874 a well was sunk in the valley below the railway station at this place to a depth of 1,500 feet, and was, during the following year, carried to a total depth of 1,650 feet. The boring was made in search of oil, but was unsuccessful; small quantities of gas were, however, found at various points throughout the boring. The record of it, kindly furnished by Mr. James Kerr, of Petrolea, is as follows:—

| | |
|---|---|
| Surface ................................ | 80 feet. |
| Red shale.............................. | 400 " |
| Blue " .............................. | 550 " |
| Black " .............................. | 400 " |
| Limestone................................ | 220 " |

It is difficult to correlate the various strata, mentioned above, with the formations that must have been passed through in this well, at least, as these formations are at present known in Ontario. The 400 feet of red shales are undoubtedly of Medina age, which probably also includes a part of the 550 feet of blue shales next met with while the lower 220 feet are undoubtedly Trenton, leaving 400 fee and part of the 550 feet to represent the Hudson River and Utica.

It is to be regretted that samples of drillings were not obtained, as this well, on account of its depth and position, would give an excellent record of the details of the formations in this part of the province.

### *Well in Barton Township.*

Barton.

During the years 1864 and 1865 a company known as “T Barton Oil Co.,” was formed to prospect for oil, which project w carried out by drilling a well on lot 11, con. 7, township of Barto unfortunately, however, without success. At 873 feet the drill w in bluish shale, which probably represents the upper beds of the H son River formation. The boring was begun in the Niagara limeston which, with the underlying Clinton limestones and shales, contin for 250 feet.

The record was as follows :—

| | | | |
|---|---|---|---|
| Limestone with a little shale.. | 250 | feet | Niagara and Clinton. |
| White sandstone............ | 5 | “ | Grey band. ? |
| Red shale with bluish bands.. | 595 | “ | Medina. |
| Bluish and greyish shales..... | 23 | “ | |

Small quantities of oil were obtained at 700 and 780 feet, as well a considerable flow of water from the latter depth.

### *Well at Mount Albion.*

MountAlbion.

Some years ago an incorporated company, known as the Eme Natural Gas Light and Fuel Co., presided over by Mr. E. O. Emer of Olean, Pa., drilled for gas at Mount Albion. The boring was car to a depth of 1,500 feet without finding gas or oil, and was fi abandoned.

## WELL IN LINCOLN COUNTY.

### *Well near St. Catharines.*

St. Catharines.

This well was sunk by the St. Catharines Natural Gas Co. du the year 1888, on “Broderick's farm,” lot 4, con. 3, township Louth, the record being as follows :—

| | | | |
|---|---|---|---|
| Surface.................. | 90 | feet. | |
| Red shale................ | 548 | “ | Medina. |
| Blue “ ............... | 700 | “ | Hudson River and U |
| Black to blue shale........ | 168 | “ | |
| Limestone................ | 667 | “ | Trenton. |
| White quartzose sandstone.. | 27 | “ | |
| | 2,200 | feet. | |

Large quantities of fresh water were met with in a bed of g seven or eight feet thick at a depth of fifty-seven feet from the sur and at 220 feet saline waters were met with, below which

1.

the hole was found to be dry, though the casing was carried to 272 feet. A small pocket of gas was opened at 275 feet or 185 feet in the Medina, from which formation further south, in the townships of Humberstone and Bertie, are drawn the great supplies of the Provincial Natural Gas and Fuel Co. This small flow of gas soon ceased, and no more was found till the sandstone underlying the Trenton was pierced, where, at a depth of 2,185 feet a flow of about 4,000 cubic feet per diem was obtained. The well was eventually torpedoed with two hundred pounds of nitro-glycerine without beneficial results.

The derrick-house floor stood about 297 feet above mean tide level, the Trenton being, therefore, 1,209 feet below.

## WELLS IN WELLAND COUNTY.

### *Well at Thorold.*

**Thorold.**

During the spring of 1888 a company was formed of citizens of Thorold, under the title of "The Thorold Natural Gas Company," the object being to bore for natural gas. In furtherance of this intention a well was begun and finished in the same year, reaching a point 525 feet into the Trenton limestone, and 2,430 feet from the surface, traversing in this distance the Clinton, Medina, Hudson River and Utica formations.

The record of boring is as follows :—

| | | | |
|---|---|---|---|
| Surface | 43 ft. | | |
| Dark brown limestone | 7 " | Clinton | 77 ft. |
| Shale | 70 " | | |
| Red sandstone | 30 " | Medina | 930 " |
| Shale | 57 " | | |
| Grey sandstone | 30 " | | |
| Shale | 813 " | | |
| Shale | 700 " | Hudson River | 700 " |
| Shale | 155 " | Utica | 155 " |
| Limestone | 525 " | Trenton | 525 " |
| | 2,430 | | 2,430 |

Brine was met with at 284 feet, and was cased off, the casing extending to 312 feet, below which water was not found in sufficient quantity to necessitate further casing. A very small flow of gas, not sufficient to be of use commercially, was struck at 2,430 feet, which would be near the base of the Trenton.

This well is 517 feet above tide, making the summit of the Trenton, therefore, about 1,388 feet below. The Medina formation, which is generally in Ontario the most productive of gas, is here found to be barren.

*Wells at Port Colborne.*

Port Colborne

*No. 1 Well.*—Port Colborne was the first town in Canada to use natural gas. Early in 1885 a company was formed under the title of "The Port Colborne Natural Gas, Light and Fuel Company," o which Mr. C. McNeal, of that place, was president, and Mr. D Hughes, secretary and treasurer. Boring was at once begun at No. well, on Charlotte street, in the village, and in August, 1885, the ga was lighting Mr. D. McGillivray's store. The boring reached 1,50 feet, or 770 feet into the Medina formation, in the upper shales an sandstone of which the principal flow of gas was obtained.

The record of boring shows:—

| | | |
|---|---|---|
| Surface | 12 feet. | |
| Grey limestone | 13 " | Corniferous. |
| " " | 7 " | Onondaga and Lower Helderberg; small flows of gas at 150, 252 and 415 feet. |
| Dolomite | 3 " | |
| Shale and dolomite | 55 " | |
| Dolomite and gypsum. | 57 " | |
| Dolomite | 108 " | |
| Shales and dolomite with gypsum | 185 " | |
| Shaly dolomite | 30 " | Guelph and Niagara |
| Brown dolomite and dark blue shales towards bottom | 188 " | |
| Marls and dolomite | 72 " | Clinton. |
| Red shales with thin bands of white sandstone | 50 " | Medina; main flow of gas 764 feet. |
| Red and white sandstone | 53 " | |
| Soft red shales with bands of grey and green | 667 " | |

Casing was not used except as a conductor through the surface deposi s. Fresh water was struck at twenty-six feet and strong saline water w h sulphuretted hydrogen at 452 feet, the water being eventually shut off by means of an inch and a-quarter pipe resting in a rubber pac er some distance below the lower water seam and above the main as seam, which affords a daily flow of about 25,000 cubic feet. This w ell has been drawn on steadily since August, 1885, the gas being used to light a number of shops and in McNeal's hotel.

Port Colborne

*No. 2 Well.*—This well, drilled by Mr. M. Richardson, is in rear of his factory, east of the Welland canal, in the village of Port Colborne, and distant about one mile from No. 1 well. The boring reached a depth of 770 feet, being then in the red shales of the upper part of the Medina. Gas was struck at 762 feet, having a daily flow of about 25,000 cubic feet per diem. This gas is used to heat and light several private residences in the immediate vicinity. I believe that this well has since been connected with the company's mains. Salt water was not met with in this boring.

*No. 3 Well.*—This well, drilled by Mr. S. Hopkins, and known also as "Hopkins's well," is in the village, a short distance north of No. 1. The depth reached was 771 feet, gas being struck at 765 feet. Water has given great trouble here, and at the time of my visit had so far gained on the gas as to render the well useless and cause its abandonment. I was informed that the great trouble arose from the water having been imperfectly shut off, the packer having stuck in the casing. This well, which had probably as large a flow as either of the other two, has, however, I believe, been since resuscitated and connected with the company's mains.

It will be seen on reviewing the above that Port Colborne has, from three wells, a daily flow of gas of about 70,000 cubic feet, all of which is obtained from the upper beds of the Medina at a depth of from 762 to 765 feet below the surface, and about 175 feet below tide level.

*Mutual Co.'s Well.*—This well was sunk on lot 29, concession 1, township of Wainfleet, in conjunction with the Port Colborne Natural Gas and Fuel Co., for the purpose of increasing the supply of gas for the village. No data are available beyond the fact that the flow of gas obtained was small, amounting to only 5,000 cubic feet per diem.

### *Well west of Port Colborne.*

West of Port Colborne.

During 1866 a well was sunk about one mile west of Port Colborne by a company under the direction of Mr. L. G. Carter, of Port Colborne, of which, however, I was unable to obtain reliable information but was led to believe that the boring was made to a depth of about 800 feet when the tools were lost and the hole abandoned. At the time of drilling, the well is reported to have afforded large quantities of gas, Mr. Jefferson Steele, on whose property the well was sunk having used it for some years in his dwelling. The company was formed to explore for oil, for which purpose the well was sunk, no oil was obtained. At 800 feet the drill would be in the Medina sandstone from which the gas probably comes.

### *Wells at Niagara Falls South.*

Niagara Falls South.

During 1888 two wells were sunk near this place by a local company from which small flows of gas were reported.

*No. 1 Well.*—This well was sunk on McGlashan's farm, lot 158, Stamford township to a depth of 840 feet; the following section shows that this was 490 feet below the summit of the Medina formation:

| | | | |
|---|---|---|---|
| Surface | 43 | feet. | |
| Limestone | 143 | " | Niagara. |
| Shale | 24 | " | |
| Shale | 140 | " | Clinton. |
| White quartzose sandstone | 24 | " | Medina. |
| Shale and sandstone | 466 | " | |

Casing was carried 117 feet into the Niagara limestone or to a depth of 160 feet from the surface effectually shutting off all water. Gas, having an estimated flow of 4,000 cubic feet per diem, was struck at 215 feet, in the upper beds of the Clinton formation.

*No. 2 Well.*—This boring was made immediately south of No. 1, on lot 172 of the same township and was carried to a depth of 1,000 feet. Unfortunately no record of the rocks traversed was obtained. The boring was cased to a depth of 280 feet and gas in similar quantity to that obtained at No. 1, was found at 380 feet presumably in the upper sandy strata of the Medina formation.

### *Wells of the Provincial Natural Gas and Fuel Company.*

Provincial Natural Gas and Fuel Company.

During the spring of 1890 the above company was incorporated with a capital stock of $500,000, with Mr. Peter Maclaren, of Perth, president, and Mr. Eugene Coste, manager. This company had existed during the previous year under the provisional title of the Lincoln and Welland Natural Gas Company, and while under the latter title the company commenced operations. On the 15th of July, 1889, drilling was begun on what was to be known as No. 1 well, after which drilling was carried on steadily until thirteen wells were completed, from the smallest of which the flow was 47,000 cubic feet, and from the largest a flow of 8,500,000 cubic feet per diem.

The log and elevation of No. 1 well are an index to those which followed, the rocks traversed and the elevation of each being almost identical.

*No. 1 Well* is on lot 35, concession 3, township of Bertie, county of Welland, and is 371 feet above Lake Ontario, and 618 feet above tide level. The boring was begun in the Corniferous limestone and

Provincial Natural Gas and Fuel Co.

continued to a depth of 846 feet, at which point the drilling was 111 feet in the Medina sandstones and shales.

The drillings show the following record:—

| | | | |
|---|---|---|---|
| Surface | 2 | feet. | |
| Dark grey lime | 23 | " | Corniferous. |
| Grey and drab dolomites, black shales and gypsum | 390 | " | Onondaga. |
| Grey dolomite | 240 | " | Guelph and Niagara. |
| Black shales | 50 | " | Niagara. |
| White crystalline dolomite, grey towards bottom | 30 | " | Clinton. |
| Red sandstone | 55 | " | Medina. |
| Red shales | 10 | " | |
| Blue " | 5 | " | |
| White sandstone | 5 | " | |
| Blue shale | 20 | " | |
| White sandstone "Gas rock." | 16 | " | |

Fresh water was cased off at 284 feet, and at 548 feet salt water was met with; the hole was afterwards cased to a depth of 596 feet, below which point there was no water.

Gas to the extent of 1,000,000 cubic feet was struck at 836 feet, though on the well being "shot" the flow increased to 2,050,000 cubic feet per diem, at which figure it now stands.

It will be seen on referring to the log that the source of supply lies in the second streak of white sandstone in the upper beds of the Medina formation.

*No. 2 Well.*—This well is on lot 2, concession 2, township of Humberstone, and was sunk to a depth of 851 feet. As the record of the rocks in this well is almost identical with that of No. 1, it has not been thought necessary to give it in detail. A summary of it is: surface deposits, 6 inches; depth to summit of Medina, 735 feet; gas struck, 842 feet; salt water struck, 550 feet; casing, 600 feet; capacity of well, 375,000 cubic feet per diem.

*No. 3 Well.*—On lot 1, concession 15, township of Bertie, was drilled to a depth of 836 feet and affords gas to the extent of 600,000 cubic feet per diem. Surface deposits, 5 feet; summit of Medina, 715 feet; gas struck, 820 feet; salt water struck, 540 feet; casing, 590 feet.

*No. 4 Well.*—On lot 3, concession 1, township of Humberstone; 875 feet deep; capacity, 2,200,000 cubic feet per diem; surface deposits, 17 feet; summit of Medina, 760 feet; gas struck, 863 feet; salt water struck, 565 feet; cased to summit of Medina, 760 feet.

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l Gas
uel Co.

*No. 5 Well.*—On lot 34, concession 3, township of Bertie; 842 feet deep; capacity, 8,500,000 cubic feet per diem; surface deposits, 8 feet summit of Medina, 725 feet; gas struck, 833 feet; salt water struck 550 feet; cased to 582 feet.

*No. 6 Well.*—On lot 1, concession 1, township of Humberstone 897 feet deep; capacity, 70,000 cubic feet per diem; surface deposits, 30 feet; summit of Medina, 770 feet; gas struck, 880 feet salt water struck, 570 feet; cased to summit of Medina, 770 feet.

*No. 7 Well.*—On lot 3, concession 2, township of Humberstone 840 feet deep; capacity, 3,000,000 cubic feet per diem; surface deposits, 18 feet; summit of Medina, 725 feet; gas struck, 824 feet; salt water struck, 540 feet; cased to summit of Medina, 725 feet.

*No. 8 Well.*—On lot 27, concession 3, township of Bertie; 8[illegible]0 feet deep; capacity, 47,000 cubic feet per diem; surface deposits, 4 feet; summit of Medina, 715 feet; gas struck, 819 feet; salt water struck, 540 feet; cased to summit of Medina, 715 feet. This well, with the exception of No. 14, has the smallest capacity of all those sunk by the company, and was immediately plugged and abandoned.

*No. 9 Well.*—On lot 7, concession 2, township of Humberstone, reached a depth of 851 feet. Capacity, 3,500,000 cubic feet per diem; surface deposits, 32 feet; summit of Medina, 730 feet; gas struck, 836 feet, or four feet in the second white sandstone which was 19 feet thick; salt water struck, 550 feet; cased to summit of Medina, 730 feet. A slight change in the thickness of the beds is noticeable in this well. The first white sandstone which, in No. 1 well, is five feet thick, has in this instance a thickness of twenty feet, beneath which is found twelve feet of dark shale instead of twenty feet as in No. 1.

*No. 10 Well.*—On lot 6, concession 1, township of Humberstone, 87[illegible] feet deep. Capacity, 4,500,000 cubic feet per diem; surface deposits, 12 feet; summit of Medina, 750 feet; gas struck, 855 feet; salt water struck, 560 feet; cased to summit of Medina (750 feet).

*No. 11 Well.*—On lot 4, concession 14, township of Bertie, 816 feet deep. Capacity, 300,000 cubic feet per diem; surface deposits, [illegible] feet; summit of Medina, 695 feet; gas struck, 800 feet; salt water struck, 495 feet; cased to 709 feet.

*No. 12 Well.*—On lot 9, concession 2, township of Humberstone 843 feet deep. Capacity, 5,500,000 cubic feet per diem; surface deposits, 20 feet; summit of Medina, 730 feet; gas struck, 828 feet salt water struck, 525 feet; cased to 732 feet. The Clinton dolomite was struck at 695 feet and continued to a depth of 732 feet, showing thereby a thickness of thirty-seven feet, a slight thickening when co[illegible]

Provincial Natural Gas and Fuel Co

pared with that as shown in No. 1 well. The gas-rock or second bed of white sandstone in which the well finished was met with at 825 feet, being therefore penetrated a distance of eighteen feet.

*No. 13 Well.*—On lot 9, concession 1, township of Humberstone, 900 feet deep. Capacity, 300,000 cubic feet per diem; surface deposits, 15 feet; summit of Medina, 745 feet; gas struck, 855 feet; salt water struck, 570 feet; cased to 749 feet.

*No. 14 Well.*—This well, on lot 6, concession 15, township of Bertie, was at the time of my last visit—13th March, 1891—not completed, having reached a depth of only 1,600 feet, the drill being then in the shales of the Hudson River formation. A small flow of gas was noted at 705 feet in the red sandstone at the summit of the Medina formation. The gas-rock of the district, struck at 762 feet, continued for a distance of sixteen feet and was found to be barren.

This well indicates very closely the probable boundary of the gas-field on its north-eastern side, and will be watched with considerable interest as it is the intention of the company to carry it to the Trenton limestone, and thereby test at this point the gas-producing properties of that formation.

Daily production.

It will be seen on reference to the foregoing that this company has an available supply of 30,895,000 cubic feet of gas per diem, made up as follows:—

| | | |
|---|---|---|
| No. 1 Well | 2,050,000 | cub. ft. |
| " 2 " | 375,000 | " |
| " 3 " | 600,000 | " |
| " 4 " | 2,200,000 | " |
| " 5 " | 8,500,000 | " |
| " 6 " | 70,000 | " |
| " 7 " | 3,000,000 | " |
| " 9 " | 3,500,000 | " |
| " 10 " | 4,500,000 | " |
| " 11 " | 300,000 | " |
| " 12 " | 5,500,000 | " |
| " 13 " | 300,000 | " |
| | 30,895,000 | cub. ft. |

A contract having been made between the above-mentioned company and a certain Buffalo gas company, mains were being laid during the latter part of 1890, and it is confidently expected that before many months Buffalo will be largely supplied from this field. Gas will also probably be supplied to those Canadian towns and villages in the immediate vicinity of the latter company's wells.

Since the discovery of so large a gas field, many individuals throughout the county have drilled for and obtained gas in quantity, in nearly all instances from the same strata as in the company's wells. The most important of these independent wells are: The Carroll, Edward Near, Hopkins's No. 2, Cronmiller and White, and Reebe.

### *Carroll's Well.*

Carroll's.

This well, on lot 4, concession 1, township of Humberstone, was begun on the 19th March, 1890, and reached a depth of 917 feet, or twenty-two feet into the red shales immediately underlying the productive white sandstone bed. Gas was struck at 883 feet, having a daily flow of 990,000 cubic feet. This supply is used in the firing of limekilns operated by Messrs. Carroll Bros., as well as for general heating and illuminating purposes in and around the lime works.

### *Edward Near Well.*

Edward Near.

A well was sunk by Mr. Edward Near on lot 29, concession 2, township of Humberstone, to a depth of 800 feet, wherein, at 675 feet, and in the white sandstone, gas to the extent of 415,000 cubic feet per day, was found. It is being drawn upon for the lighting and heating of the village of Humberstone.

### *Hopkins's No. 2 Well.*

Hopkins's No. 2.

This well, on lot 28, concession 2, township of Humberstone, reached a depth of 800 feet, gas to the extent of 400,000 cubic feet per day being obtained at 670 feet.

### *Cronmiller and White Well.*

Cronmiller and White.

Near the village of Port Colborne and close to the brewery operated by Messrs. Cronmiller and White, a well was sunk by that firm to a depth of 800 feet, the drilling terminating in the red shales immediately underlying the gas-bearing sandstone. Gas having a flow o 6,000 cubic feet per diem was found at 675 feet.

### *Reebe's Well.*

Reebe's.

On lot 6, concession 1, township of Wainfleet, a few miles west Port Colborne, a well was sunk by Mr. John Reebe to the depth of 8 feet, and just into the red shales beneath the gas-bearing sandston of the wells in the two townships to the east. Drilling was co menced at the base of the Corniferous, when the following series of rocks were traversed :—

| | | |
|---|---|---|
| Drab and grey dolomites, shales and gypsum | 390 feet. | Onondaga, |
| Dolomite, grey | 240 " | Guelph & Niagara. |
| Shale, black | 55 " | Niagara. |
| Dolomite | 30 " | Clinton. |
| Sandstone, red | 45 " | Medina. |
| Shale, red and blue | 40 " | |
| Sandstone, white | 20 " | |

Casing was carried to a depth of 630 feet, effectually shutting off all water; and gas, having a daily flow of 400,000 cubic feet, was obtained at 685 feet at the summit of the Clinton dolomite. Although this well was carried down to and through the usual gas-bearing sandstone, no further supply of gas was obtained. The gas produced at the well is being used for burning lime in kilns operated by the owner.

It will be seen on reference to the above "log" that the strata in the upper part of the Medina differ somewhat from those in wells further east, where there are shown to be two beds of white sandstone separated by twenty feet of blue shale. It is to be regretted that more accurate records or specimens of the drillings are not available from wells drilled at intermediate points to indicate which of these beds is missing. It is presumed, however, that the white sandstone at the bottom of this well corresponds with the "gas rock" of the wells east of Port Colborne.

Several other wells of minor importance have been drilled throughout this county, of which no information is available.

## WELLS IN WATERLOO COUNTY.

### *Well at Waterloo.*

This well, in the town of Waterloo, was sunk during 1867 to a depth of 1,120 feet, of which the record is as follows :— Waterloo.

| | Feet. | |
|---|---|---|
| Surface | 130 | |
| Limestone | 40 | Onondaga, 77 feet. |
| Gypsum | 17 | |
| Shale | 20 | |
| Limestone | 340 | Guelph, Niagara and Clinton. |
| Shale, blue | 114 | Clinton and Medina. |
| Shale, red | 459 | Medina. |

This well sunk for salt was very unsuccessful, only bitter saline water being met with at 800 and 900 feet. These depths would indicate that the water seams were contained in the red shales of the Medina which elsewhere in Ontario are noted for these peculiar saline waters.

Elevation of the well above tide about 800 feet.

A well in Waterloo, presumably this one, was afterwards deepened to 1,800 feet by Mr. John McEwen, the record of which is, unfortunately, not available.

In 1883 another well was sunk at this place by Mr. John Savage, of Petrolea, whose record and papers regarding it have been mislaid. He, however, assured me that neither gas, oil nor salt was met with.

### *Well in Berlin.*

Berlin.

In the town of Berlin and about half a mile east of the Grand Trunk Railway station, a well was unsuccessfully sunk for water to the depth of 1,250 feet, by the gentleman last named. The rocks traversed are, according to the driller, as follows:—

| | |
|---|---|
| Surface | 187 feet. |
| Limestone | 320 " |
| " Hard rock " | 40 " |
| Limestone | 200 " |
| Shale, red | 180 " |
| Shale, green | 160 " |
| Slate, blue | 170 " |

The casing was carried to a depth of 303 feet, and at the depth of 540 feet there was a strong flow of mineral water; whether saline or otherwise, I was unable to ascertain; neither gas nor oil was noted.

I have found it impossible to correlate the rocks said to have been met with in this well with those traversed in the well at Waterloo, but a short distance to the north-west. The drilling was, however, undoubtedly begun in the Onondaga formation, represented by the upper part of the 320 feet of limestone, and, like at Waterloo, terminated in the Medina.

Elevation 1,080 feet above tide.

## WELLS IN WELLINGTON COUNTY.

### *Well at Erin.*

Erin.

A well was sunk at this place in 1888 by Mr. John Fraser, of Petrolea, which reached a depth of 800 feet and of which the following record, only, is available :—

| | | | |
|---|---|---|---|
| Limestone | 95 | feet. | Niagara. |
| Shale | 100 | " | Clinton. |
| " blue, and sand | 25 | " | Medina. |
| " red | 480 | " | |
| " blue | 100 | " | Hudson River. |

The lower 100 feet of shales are ascribed to the Hudson River formation, though of this there can be no certainty, from the fact that between the shales ascribed to the Clinton and those presumed to be the Hudson River there is but 505 feet of shales to represent the Medina formation which, further south, has an average thickness of 750 feet.

Neither gas nor oil was found in this well.

Elevation above tide 1,038 feet.

### *Well at Eden Mills,*

Regarding this well Dr. T. S. Hunt, writes as follows:—* Eden Mills.

"Another boring, at Eden Mills, on the first lot of the first range of Eramosa, was sunk 159 feet in limestone and shales, before encountering the red strata of the Medina, which were penetrated 350 feet, making a depth of 509 feet. Some white or light coloured bands were met with in the upper part of the red rocks, and at 250 feet from the surface, in what was described as a layer of black slate, a spring of saline water was encountered."

## WELLS IN BRANT COUNTY.

### *Well at Brantford.*

During 1888 a well was drilled 1,118 feet deep by the Waterous Brantford. Engine Company in the yard at their works on Dalhousie street, Brantford. The boring was made in search of gas but was unsuccessful, a very small flow, only, being obtained, though at what depth I was unable to ascertain. The boring commenced in the Onondaga, or rather in the drift immediately overlying that formation. Only an imperfect record of this well was obtained, the interpretation of which is probably as follows:—

| | | | |
|---|---|---|---|
| Surface | 63 | feet. | |
| Limestone, &c | 457 | " | Lower beds Onondago and Guelph, Niagara and Clinton, if present. |
| Blue shale | 5 | " | 530 Medina. |
| Red " | 25 | " | |
| Sandstone | 40 | " | |
| Red slate | 460 | " | |
| Dark red and blue shale | 68 | " | probably to summit of Hudson River. |

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*Geol. Surv. of Can., Rept. of Progr., 1866, p. 251.

There was a small flow of sulphurous water, at 200 feet, and at 300 feet the same was found in large quantities; it was, however, effectually cased off and no further water was met with.

Elevation 707 feet above tide.

### *Well in the Township of Brantford.*

Township of Brantford.

In the year 1888 a well was sunk on lot 16, concession 15, township of Brantford, in search of gas, which however, was unsuccessful, small quantities only being obtained. The boring reached a depth of 2,160 feet, or 210 feet beneath the summit of the Trenton limestones. Only an incomplete log, as below, and very little information was obtained respecting it :—

| | | |
|---|---|---|
| Surface.............. | 45 feet. | |
| Limestone............ | 400 " | To base of Medina. |
| " shales, &c.... | 525 " | |
| Blue shale............ | 980 " | Hudson River and Utica. |
| Limestone............ | 210 " | Trenton. |

Heavy flows of water were found at points between 200 and 300 feet, accompanied by small quantities of gas, and a small flow of the latter was again obtained, unaccompanied by water, at about 1,950 feet, undoubtedly from the upper beds of the Trenton. The quantity was not, however, sufficient to be of economic importance. Casing was carried to a depth of 520 feet, beneath which the hole was comparatively dry.

Elevation above tide, about 672 feet.

### *Well at Paris.*

Paris.

During the year 1865 a drilling was made at Paris in search of petroleum. I have been unable to obtain any later information regarding this well, of which Dr. Sterry Hunt, writes as follows:—*

" One of these (borings) is in the town of Paris, where, after 10 feet of soil, there were met 146 feet of thin bedded limestones, with shales and gypsum, beyond which, in August last, they had penetrated 99 feet in a white granular rock, a specimen of which was found to be pure dolomite, probably belonging to the Guelph formation."

Assuming that the lower ninety-nine feet be dolomite of the Guelph formation, the record to 255 feet would be as follows: —

| | | |
|---|---|---|
| Surface......................... | 10 feet. | |
| Limestone, &c.................. | 146 " | Onondaga. |
| Dolomite...................... | 99 " | Guelph. |

What the result of this boring was is not stated.

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* Geol. Surv. of Can., Rept. of Progr., 1866, p. 250.

### *Well at Cathcart (Sydenham).*

Cathcart.

At the time that the last described boring was accomplished a well had been sunk at Sydenham (now Cathcart), of which Dr. T. S. Hunt,* writes as follows:—

"A few miles to the south-west of this (Paris), at Sydenham, a boring was said to have been sunk through clay 140 feet, shale and gypsum 260 feet, after which a harder rock, doubtless the same as at Paris, was encountered."

## WELLS IN OXFORD COUNTY.

### *Wells at Tilsonbury.*

Tilsonburg.

During 1861 and the succeeding years numerous wells were sunk in and around Tilsonburg in search of oil, with, unfortunately, but little success. Oil was met with in the Corniferous limestone immediately underlying the drift deposits, but never in sufficient quantities to be considered of economic importance. In the township of Dereham, near Tilsonburg, two wells were sunk during 1861, the record kept of one of them showing, surface (clay) thirty feet, succeeded by ninety-six feet of Corniferous limestone. Oil was first found on the surface of the rock, and again at fifty-five and sixty-eight feet beneath the surface, oil from the latter depth being accompanied by water and, at intervals, by large quantities of gas.

In 1865 and 1866 a well was sunk by Messrs. Hibbard and Avery, of Tilsonburg, to the depth of 854 feet. It was reopened in 1873, and the drilling carried to a depth of 1,450 feet in the vain hope that the bore would penetrate the thick salt beds found to the north-west. Mr. Lionel Smith † says: "A brine of increasing gravity was the result, which is now, I am informed, 50° to 60° by salometer; but no salt bed was reached, as they are evidently near its edge, but not over it." In 1877 the drilling was carried, by the same company, to a depth of 1,750 feet.

Dr. Sterry Hunt examined specimens from this well, of which he writes as follows:§—"The rock, beginning at 36 feet from the surface, is a pure limestone, and specimens from 97, 100, 150 and 196 feet have a similar character. One from 210 feet is a granular dolomite, while others from 261, 273, 290 and 305 are limestones. At 365 feet is a granular dolomite, while specimens from 420 and 454 feet, are compact varieties of the same rock. At 560 feet a limestone is again met with, and a dolomite at 600, while the latest obtained specimen, at 890 feet, has the same composition."

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* Geol. Surv. of Can., Rept. of Progr., 1866, p. 251.

† Ibid., 1874-75.

§ Ibid., 1866, p. 250.

The record of this well may be rendered as follows—the first 890 feet being on the authority of Dr. Hunt and the remainder as given to me by the driller :—

| | | |
|---|---|---|
| Surface.............. | 36 feet | |
| Limestone............ | 160 " | Corniferous. |
| Dolomites and limestones | 694 " | Probably Onondaga. |
| Red marl............ | 35 " | Onondaga. |
| Dark shale........... | 825 " | |

The Corniferous is evidently traversed in the first 160 feet of rock, and is succeeded by the Onondaga, having a thickness of about 890 feet. That this is the case is evidenced by the fact that at 890 feet there were met with thirty-five feet of red marls, which, according to Dr. Hunt, form the basis of this formation. The succeeding 825 feet, termed by the driller "dark shale," probably includes all those rocks comprising the Guelph, Niagara, Clinton and part of the Medina. specimens are, unfortunately, not available, and the record of the lower part of this well must, of necessity, remain a matter of conjecture.

The Hamilton shales are wanting at Tilsonburg, though it is reported that in drilling a well about two miles south-west of the town "soapstone" was found to overlie the Corniferous for a depth of eleven feet.

During 1865 and 1866 several companies sank wells in Dereham and adjoining townships without success, though, in several of the wells, small quantities of oil were obtained. One of these, the "Lyndop and Chandler," afforded some seventy-five barrels of oil before being abandoned. Oil and water are still flowing from this well, and a specimen, collected by the writer during 1890 shows the oil to be very dark and of heavy gravity.

In all some twelve or thirteen wells were sunk, averaging, with the exception of the "Hibbard and Avery," a depth of about 500 feet.

In 1888 and 1889 drilling was again commenced, without, as in previous years, any economic result. Four wells were sunk, one to 400 feet and three reaching 200 feet, in all of which traces of oil were found and from the 400 feet well, a strong flow of sulphur water was obtained.

More or less gas was noticed in all the wells bored, arising, in every instance, from the Corniferous limestone. The history of the rise and fall of the oil excitement at Tilsonburg is brief. It seems that, for many years, the Indians of the district resorted to a well-known oil spring, a short distance south-west of the town, where they collected the black oil, for medicinal purposes. The attention of oil producers was directed to it and as early as 1861 drilling operations were begun in and around the town. The first well was sunk, in 1861, by Messrs. Watkins, Miles and Craigie, who drilled and soon after abandoned a well which afforded small quantities, only, of oil. In 1865 and 1866, Messrs. Hibbard and Avery, Lyndop and Chandler and others commenced operations, with what results has already been shown; after this operations ceased till 1873, when the Tilsonburg Salt Co. re-opened the old Hibbard and Avery well, deepening it to 1,450 feet and afterwards in 1877 to 1,750 feet. Drilling was again undertaken, in 1888 and 1889, for what purpose I was unable to ascertain, though of the results there can be no doubt.

### *Well at Burgessville.*

Burgessville.

During the year 1887, a joint-stock company was formed at this place for the purpose of sinking wells in search of gas and oil. A well was begun and finished during the year which reached a depth of 605 feet. Neither gas nor oil was found. At the depth of 185 feet beneath the surface a strong flow of sulphur water was met with; this water has been flowing continuously ever since and with no apparent diminution in quantity. No record of the boring was kept beyond the fact that the surface deposits had a thickness of 165 feet. I am indebted to Mr. E. H. Snyder, of Burgessville, for several specimens, which, on examination, proved to be as follows:—

| | | | |
|---|---|---|---|
| Specimen from........ | 280 feet. | Light blue shale, slightly calcareous. |
| " " ........ | 300 | " | " with gypsum. |
| " " ........ | 367 | " | Cream coloured dolomite. |
| " " ........ | 400 | " | Light brown " |
| " " ........ | 550 | " | Dark blue shale. |

All of these specimens are probably of rocks belonging to the Onondaga formation.

### *Wells at Norwich.*

Norwich.

Two wells have been drilled at or near this place of which but scant information is available. The deeper of the two sunk in 1885, on the property of Mr. George A. Cook, reached a depth of 2,000 feet; the drilling was done by Mr. Duncan Sinclair. Fresh water, which is now being utilized, is said to have been struck at 800 feet.

The other well is much shallower, reaching a depth of only 500 feet, wherein at 150 feet from the surface a small flow of oil accompanied by water was noted. The surface deposits were eighty feet thick.

### *Well at Harrington.*

rington.

A well was, some years ago, sunk at the village of Harrington, but no particulars of the drilling could be obtained, beyond the fact that nothing of economic value was found.

### *Well at Woodstock.*

Woodstock.

It is reported that a well was also sunk at Woodstock, at about the same time as the above, though no information relating to it could be obtained.

## WELLS IN NORFOLK COUNTY.

Norfolk County.

Numerous wells have, within the past twenty-five years, been sunk in this county, in every case, however, proving failures, when sunk in expectation of obtaining gas or oil in economic quantity. Small flows of gas were met with in several of those sunk in the northern part of the county, more especially in that drilled on Big creek, near Lyndoch. This well, was sunk in 1869 or 1870, and reached a depth of 600 feet, the surface deposits showing a thickness of about 100 feet, below which black shales, probably of Hamilton age, were found; beyond this no data have been obtained relating to the rocks pierced. From a depth of about 600 feet a strong flow of sulphur water, accompanied by a small quantity of gas, was obtained. This flow, gas and water, has been continuous.

Among other wells, in this county, may be mentioned one sunk Port Rowan, which reached a depth of 400 or 500 feet. No gas oil was obtained.

## WELLS IN ELGIN COUNTY.

### *Well at Vienna.*

Vienna.

A well was sunk here, about twenty-five years ago, about whic have been unable to obtain direct information. Dr. Hunt stat that this well was sunk at a point about forty feet above L Erie, and that the Corniferous limestone was met with bene 240 feet of clay. This is in the area supposed to be covered by ilton series, the shales of which are, however, wanting at this t.

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* Geol. Surv. of Can., Rept. of Progr., 1866, p. 250.

### *Well at Port Stanley.*

Port Stanley.

t about the same time that the boring at Vienna was made, one also made at Port Stanley, to a depth of 298 feet. The record is as ws :—

| | | |
|---|---|---|
| Surface | 172 feet. | |
| Black and brown shale | 30 " | Probably all Hamilton. |
| Light coloured shale | 16 " | |
| Limestone | 80 " | |

hat the result of this boring was has not been ascertained.

## WELLS IN MIDDLESEX COUNTY.

### *Well at the Insane Asylum, London.*

Insane Asylum, London.

ome years ago a boring was made on the grounds of the Asylum ch reached a depth of 2,250 feet, probably terminating in the er portion of the Hudson River formation. The first rock met with limestone, at or near the summit of the Corniferous, as the shales, cative of the Hamilton, found in the well at the sulphur spring in western part of the city, are missing.

he record of the boring, kindly furnished by Mr. W. Harris, of olea, is approximately as follows :—

| | | |
|---|---|---|
| Surface | 130 feet. | |
| Limestone, hard | 200 " | Corniferous. |
| " soft | 270 " | Onondaga with Guelph and Niagara, if present. |
| " hard | 100 " | |
| " | 600 " | |
| Salt and shale | 100 " | |
| Black shale | 200 " | Clinton. |
| Red " | 500 " | Medina. |
| Limestone and shale | 150 " | Hudson River. |

referring to the above log it will be seen that salt and shale, ng a combined thickness of 100 feet were found, but how h of this was actually salt I have been unable to ascertain.

he elevation of the well is about 880 feet, above tide. In reply umerous inquiries respecting the depth at which the Trenton lime-e would be reached, it may be stated that assuming the base of the lina here to be 1,220 feet below tide level and that the Hudson er and Utica have a thickness of 800 feet, the Trenton would be reached at about a depth of 2,020 feet below tide or 2,900 below the surface.

The depth at which gas, if present, would be found, is probably not less than 2,900 feet, as the rocks to be traversed in that distance between the bottom of the above mentioned well, and the summit the Trenton, are not usually gas-bearing..

### *Well at Sulphur Spring, London.*

Sulphur Spring, London.

Previous to 1865 a well was sunk at this place which afforded and to the present day affords a copious supply of sulphur water. [illegible] well was drilled to a depth of 765 feet, the rocks pierced being [illegible] follows :—

| | | |
|---|---|---|
| Surface, clay........ | 70 feet. | |
| Soft grey shale..... | 20 " | Including a band of hard black bituminous shale. |
| Limestone.... .... | 600 " | |
| Soft magnesian marl.. | 75 " | |

This boring was begun in the Hamilton shale which, as will be seen on referring to the above, has a thickness here of about twenty feet, beneath this the Corniferous was traversed, probably within a distance of 300 feet from the surface, as at that point the rock proved to be a true dolomite, probably of the Onondaga series ; assuming that such is he case the Corniferous here is, at the most, 210 feet thick.

Sulphur water was found at 114 feet, having a flow of about 1,000 gallons per hour.

### *Sunnyside Well.*

Sunnyside well.

Of this well, on lot 13, concession 4, township of London, Dr. Sterry Hunt writes as follows*:—"Another—(well)—known as the Sunnyside well, on lot 13, range 4, of London, gave clay 103 feet, beneath which were a few feet of soft shale, reposing on limestone. This was bored for 400 feet, at which depth the rock is a pure limestone, as were several other specimens from various depths, although one from 371 feet was highly magnesian."

### *Well at Strathroy.*

Strathroy.

The following record is given of a well on lot 20, concession 5, in the township of Adelaide, known as the "Strathroy Well." *

---

* Geol. Surv. of Can., Rept. of Progr., 1866, p. 249.

k was suspended at 300 feet, the record to that depth being :—

| | | |
|---|---|---|
| Surface | 100 feet. | |
| Soft shale | 50 " | Hamilton. |
| Hard limestone | 150 " | Corniferous ? |

hether work was resumed, and what the result of this boring was, ve been unable to ascertain.

*Well at Glencoe.*

Glencoe.

me years ago a well was sunk at this village under the supervision ajor John Savage, of Petrolea, to whom I am indebted for the wing log :—

| | | |
|---|---|---|
| Surface | 134 feet. | |
| Limestone | 100 " | Hamilton. |
| Soapstone | 162 " | |
| Limestone, white | 80 " | |
| " | 486 " | Corniferous and Onondaga, probably 200 feet of Corniferous. |
| Sandstone | 38 " | Onondaga. |
| Limestone, hard | 260 " | |
| Gypsum | 5 " | |
| " Hard rock " | 15 " | |
| Gypsum | 3 " | |
| " Hard rock " | 7 " | |
| Salt and shale | 104 " | |
| " Hard rock " | 116 " | Probably terminating in the Guelph. |
| Total depth | 1,510 " | |

the thirty-eight feet of so-called sandstone there was a strong of mineral water of what description I am, however, unable to . At 1,290 feet salt and shale were pierced, having a combined kness of 104 feet.

he drilling was, in all probability, begun in the so-called " upper " of the Hamilton formation, and terminated in the base of the ndaga or summit of the Guelph. Throughout the log the term rd rock " undoubtedly means dolomite, and " soapstone " the shales he Hamilton formation.

*Wells in south-west part of Middlesex.*

South-western Middlesex.

hroughout the south-western portion of Middlesex numerous wells been sunk to a depth of about 550 feet in search of oil, unfortely, finding only very small quantities.

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Geol. Surv. of Can., Rept. of Progr., 1866, p. 248.

One well in the township of Metcalfe, lot 24, concession 13, ga the following record :—

| | | | |
|---|---|---|---|
| Surface (clay) | 48 | feet. | |
| Black shale | 75 | " | Portage. |
| Soapstone, etc | 273 | " | Hamilton. |
| Limestone | 104 | " | Corniferous? |

Records of two wells sunk in the township of Mosa, have been served. One of these, on lot 5, concession 7, showed :—

| | | | |
|---|---|---|---|
| Surface (clay) | 50 | feet. | |
| Black shale | 10 | " | Portage. |
| Soapstone, &c | 230 | " | Hamilton. |
| Limestone | 262 | " | Corniferous? |

Another, on lot 3, concession 4, gave :—

| | | | |
|---|---|---|---|
| Surface (clay) | 88 | feet. | |
| Black shale | 6 | " | Portage. |
| Soapstone, &c | 243 | " | Hamilton. |
| Limestone | 177 | " | Corniferous? |

### *Well at Parkhill.*

**Parkhill.**

In 1884 a well was sunk at Parkhill, by a syndicate of citizens of that place, under the title of the Parkhill Salt Works Company, to the depth of 1,300 feet, passing through one salt-bed and into the second to a depth of twenty feet. The surface deposits showed a thickness of about 170 feet, and were immediately underlain by limestone.

All the documents, etc., belonging to the company were destroyed by fire, and therefore no detailed record of the well could be obtained, a loss very much to be regretted as this well, by its relative position and depth, would have proved a useful factor in working out the details of the geology of the western peninsula of Ontario.

Owing to the decline in the price of salt the block, at the time of my visit, had not been completed, and the well, therefore, was not made use of.

### *Wells in north-west Middlesex.*

**North-west Middlesex.**

During the earlier years of the oil excitement numerous wel were sunk throughout the townships of McGillivray, Williams (ea and west), and Adelaide in Middlesex, and Bosanquet and W wick in the county of Lambton. Of those in Middlesex few reac a depth of 500 feet, and but small quantities of oil were anyw obtained.

he following record of a well sunk near Ailsa Craig station on the ıd Trunk Railway, is from the report of the Geological Survey for ; :—

| | | |
|---|---|---|
| Surface (clay) | 75 feet. | |
| Limestone, soft | 185 " | Hamilton. |
| Limestone | 113 " | |

small quantity of oil was obtained at 275 feet from the surface.

ıother well, near the above, showed, according to the driller, the wing section :—

| | | |
|---|---|---|
| Surface | 65 feet. | |
| Limestone | 5 " | Hamilton. |
| Soapstone | 6 " | |
| Limestone | 80 " | |
| Soapstone | 50 " | |
| Limestone | 144 " | |

t a well recently sunk in Biddulph township, about five miles north of Lucan, 100 feet of surface deposits rested on limestone which penetrated 260 feet, in all 360 feet. The limestone, probably of ıiferous age, afforded an abundant supply of fresh water.

either gas nor oil was met with.

### *Well at Sylvan.*

ı well was bored in 1888 on lot 15, concession 15, township of West liams, to a depth of 200 feet, of which 175 feet was surface. At 180 195 feet from the surface gas was met with in large quantities, dering the well, which was sunk for water, valueless. It was the ntion, at the time of my visit, however, to bore deeper in expectaı of finding a larger quantity of gas. I have not heard whether has been done or not. Sylvan.

have been informed by several drillers, who have operated in this rict, that in nearly all the wells sunk in the townships of Williams, anquet, Warwick and McGillivray, gas was obtained in no inconrable quantities. In these cases, as the wells are shallow, the gas ıld necessarily emanate from the base of the Hamilton or summit he Corniferous formation.

## WELLS OF THE SALT REGION.

### *Wells at Goderich.*

f the wells sunk at this place the most important is undoubtedly bored by Mr. Henry Attrill in 1876. Work was begun on the of March of that year and bed rock reached on the 15th of April Goderich.

at a depth of seventy-eight feet nine inches, the record of the superfici deposits being as follows :—

| | | | | |
|---|---|---|---|---|
| Gravel | 14 | feet | 0 | inches. |
| Blue clay | 31 | " | 0 | " |
| Boulders | 10 | " | 0 | " |
| Gravel | 4 | " | 0 | " |
| Boulders | 13 | " | 0 | " |
| Sand and clay | 6 | " | 9 | " |

The boring was then continued by means of a 2½ inch diamond drill a depth of 365 feet from the surface to which point the well was case excluding all water. Below this the drilling was continued to a dep of 1,517 feet, a two inch diamond drill being employed. The drilli was completed on the 6th of December, 1876.

The record of the drilling has been summarized by Dr. Ste Hunt, as follows :*—

| | | | | |
|---|---|---|---|---|
| Dolomite, with thin limestone layers | 278 | feet | 3 | inches. |
| Limestone, with corals, chert, and beds of dolomite | 276 | " | 0 | " |
| Dolomite, with seams of gypsum | 243 | " | 0 | " |
| Variegated marls, with beds of dolomite. | 121 | " | 0 | " |
| Rock-salt, 1st bed | 30 | " | 11 | " |
| Dolomite, with marls towards the base | 32 | " | 1 | " |
| Rock-salt, 2nd bed | 25 | " | 4 | " |
| Dolomite | 6 | " | 10 | " |
| Rock-salt, 3rd bed | 34 | " | 10 | " |
| Marls, with dolomite and anhydrite | 80 | " | 7 | " |
| Rock-salt, 4th bed | 15 | " | 5 | " |
| Dolomite and anhydrite | 7 | " | 0 | " |
| Rock-salt, 5th bed | 13 | " | 6 | " |
| Marls, soft, with anhydrite | 135 | " | 6 | " |
| Rock-salt, 6th bed | 6 | " | 0 | " |
| Marls, soft, with dolomite and anhydrite. | 132 | " | 0 | " |

It will be seen on referring to the above that in a thickness of feet, or from the top of the first salt bed to the base of the sixth, t is a thickness of rock-salt traversed amounting to 123 feet. This is the deepest in the district, reaching, as it does, the sixth bed, in the most of the other wells the bore ceases in either the fi third.

The other wells at Goderich and immediate vicinity are :—

Platt's Well, operated by Jno. S. Platt.
Ontario " " North American Chemical Com
Saltford " " Peter McEwen.

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*Geol. Surv. of Can., Rept. of Progr., 1876-77.

Dominion Well, operated by Jos. Kidd, jr.
Ogilvie and Hutchison Well, operated by Ogilvie and Hutchison.
International Well, not in operation.
Star Salt " "

**Platt's well.**

*latt's Well* was sunk about 1875, reaching a depth of 1,075 feet. was struck at 990 feet from which depth the brine is now being ped.

**Ontario well.**

*he Ontario Well* was sunk in 1867, the depth attained being 1,127 or two feet lower than the base of the first salt bed.

**Saltford.**

*he Saltford Works Well*, drilled in 1865 by Mr. P. McEwen, was first well sunk in Ontario for the production of salt, and has been of the most successful, having been operated continuously by the ent owner. The "block" and well are situated in Saltford, a ırb of Goderich, on the north side of the Maitland river. The drill was completed at the base of the first salt bed, a depth of 1,000 feet.

**Dominion well.**

*he Dominion Well*, sunk about 1868, reached a depth of 1,120 feet.

**Ogilvie and Hutchison well.**

*gilvie and Hutchison Well*, situated on the Lake shore in the har- r, is the most recently completed, the boring having been made in 2. The depth attained was 1,100 feet, reaching, it is stated, third salt bed.

**International well.**

*he International Well* was sunk in 1874 by Mr. Joseph Kidd, Sr., has a depth of 1,170 feet. The well is on the Lake shore at the hern boundary of the town and the "block" was at one time largest in Ontario, but owing to the failure of Mr. Kidd it has been in operation for some years. The record of this boring is, rding to Mr. P. McEwen, the driller, as follows :—

| | | |
|---|---|---|
| Blue clay, limestone boulders | 100 | feet |
| Limestone boulders, and gravel | 40 | " |
| Sandstone and limestone alternate beds | 510 | " |
| Hard flinty limestone | 300 | " |
| Blue shale, thin streaks of red shale | 84 | " |
| Gypsum | 6 | " |
| Brown limestone, soft | 14 | " |
| Rock salt, 1st bed | 19 | " |
| Brown limestone, very hard | 30 | " |
| Rock salt, 2nd bed | 24 | " |
| Blue shales and clays | 3 | " |
| Rock salt, 3rd bed | 32 | " |
| Brown limestone, lighter than preceding | 8 | " |
| | 1,170 | |

But little remains to be written of the salt wells in Ontario a has been very little activity in the way of boring since that unde by Mr. Attrill at Goderich. In the report of the Geological ſ for 1866, page 263 may be found Dr. Sterry Hunt's article on ' springs," again in that for 1866-69 he reports on "The Goderi region" and in the report for 1876-77 there is an article by l Mr. Attrill's exploration in the Goderich salt region. In the report survey for 1874-75, Mr. Lionel Smith writes on the Canadian salt in

### WELLS IN HURON COUNTY.

| | Depth. Feet. | 1st Salt. Feet. | Year sunk | E. ab |
|---|---|---|---|---|
| Wingham | 1,185 | 1,090 | (?) | |
| Brussels | 1,244 | .. .. | 1872 | |
| Brussels, ¾ mile south | 1,000 | 970 | 1873 | |
| Blyth | 1,215 | 1,125 | 1879 | |
| Clinton | 1,239 | 1,151 | 1867 | |
| Seaforth | 1,135 | 1,035 | 1870 | |
| Hensall | 1,206 | 1,090 | 1880 | |
| Exeter | 1,251 | 1,135 | 1881 | |

Wingham.

*Wingham.*—This well, operated by the Gray, Young and Sp Company, at Wingham, is on the south-east corner of lot 4 cession 13, East Wawanosh, and reached a depth of 1,185 The record of boring is as follows :—

| | | |
|---|---|---|
| Surface | 96 | feet. |
| Grey limestone | 100 | " |
| Dolomite | 250 | " |
| Dolomite with gypsum and limestone | 275 | " |
| Limestone with blue shale and dolomite | 369 | " |
| Rock-salt | 30 | " |
| Limestone | 65 | " |
| | 1,185 | " |

Brussels.

*Brussels.*—This well was described by Mr. J. Gibson in an entitled "Salt Deposits of Ontario." * The following is the given by him :—

| | | |
|---|---|---|
| Surface | 16 | feet. |
| Limestone | 100 | " |
| Limestone, magnesian | 266 | " |
| Limestone, with chert | 180 | " |
| Soapstone | 353 | " |
| Dolomite, grey | 97 | " |
| Dolomite | 168 | " |
| Sandstone, dark brown | 64 | " |
| | 1,244 | " |

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* *American Journal of Science*, vol. V., 3rd series.

The first limestone is probably of Corniferous age, beneath which is found the Onondaga series of magnesian limestones, dolomites and shales, and the sandstone—so-called—is, in all probability, referable to the Guelph series of dolomites which are usually light to dark brown and arenaceous in appearance.

Saline waters were met with at 1,012 feet, and at 1,200 feet traces of oil and gas were noticed.

This well is apparently just outside the edge of the salt basin and defines very closely its geographical limit at this point, as, at a distance of only three-quarters of a mile south-west of the town, salt was struck in considerable quantities in the well now being operated by Mr. F. C. Rogers.

Blyth.

*Blyth.*—The following is the driller's record of this well:

| | | |
|---|---|---|
| Surface | 104 | feet. |
| Limestone | 300 | " |
| (?) | 346 | " |
| Shale, black | 100 | " |
| Hard rock | 170 | " |
| Shale | 105 | " |
| Rock salt | 90 | " |

Considerable gas was obtained in the black shales at a depth of 150 feet. No further information regarding the well has been obtained.

Clinton.

*Clinton.*—The "Stapleton Well," owned and operated by Mr Henry Ransford, was drilled by the owner in 1867, and I am indebted to him for the following record of boring:—

| | | |
|---|---|---|
| Surface | 67 | feet. |
| Limestone | 413 | " |
| Limestone, cherty and dolomite | 204 | " |
| Limestone | 176 | " |
| Limestone, cherty and dolomite | 36 | " |
| Shale, limestone, gypsum and marls | 255 | " |
| Rock salt, first bed | 15 | " |
| Shale, gypsum and salt | 48 | " |
| Rock salt, second bed | 25 | " |
| | 1,239 | " |

Seaforth.

*Seaforth.*—The following record of boring at Messrs. Coleman and Gouinlock's "block," is taken from Mr. Gibson's article, already referred to:—*

---

* *American Journal of Science*, vol. V., 3rd series.

| | | | |
|---|---|---|---|
| Surface | 25 | feet. | |
| Limestone, dark grey | 400 | " | |
| " magnesian | 310 | " | with chert. |
| Shales, limestone and marls | 250 | " | |
| Gypsum, salt and shale | 50 | " | |
| Rock salt | 100 | " | |
| | 1,135 | " | |

Boring finished in salt.

Hensall.

*Hensall.*—I am indebted to the proprietor and driller, Mr. George McEwan, for the following information regarding his well. The boring was made in 1880, in the southern part of the village of Hensall, to a depth of 1,206 feet, drilling being stopped in the salt strata:—

| | | |
|---|---|---|
| Surface | 88 | feet. |
| Limestone, hard | 150 | " |
| " soft | 75 | " |
| Dolomite | 25 | " |
| Limestone (magnesian ?) | 462 | " |
| Shale | 230 | " |
| Marly shale | 60 | " |
| Salt and shale | 116 | " |

WELLS IN BRUCE COUNTY.

| — | Depth, feet. | First salt, feet. | Year sunk. | Elevation above tide. |
|---|---|---|---|---|
| Teeswater | 1,180 | .... .... | ........ | [illegible] |
| Kincardine | 1,007 | 947 | ...... | [illegible] |
| do | 957 | ......... | 1868 | [illegible] |
| Inverhuron | 1,007 | ...... ... | 1872 | [illegible] |
| Port Elgin | 1,000 | ... ...... | ....... | [illegible] |
| Southampton | 1,255 | ... ...... | 1868 | [illegible] |

Inverhuron.

*Inverhuron.*—The following, taken by Mr. J. Lionel Smith, is all the information available: * "A well has since been sunk at Inverhuron, nine miles north of Kincardine, on the shore between Port Elgin and the latter place. The driller, J. S. McEwan, reports that the strata for 895 feet were identical with those at the Kincardine well, and that they then encountered blue shale and gypsum, slightly impregnated with salt; after which came Niagara shales, and at 1,007 feet, hard limestone, holding black water with an offensive odour."

Port Elgin.

*Port Elgin.*—Fruitless attempts to obtain salt at this place were made in 1869 and 1870. No information is available beyond that to be found in "The Geology of Canada," 1866-69, wherein Dr. Sterry Hunt states that at a depth of 890 feet the boring was being carried ugh red shales. These shales are probably of Medina age, as the was begun in the base of the Onondaga, which appears on the ace at Southampton, five miles further north.

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*Geol. Surv. of Can., Rept. of Progr., 1874-75.

Southampton.

*uthampton.*—To the courtesy of the driller, Mr. Wm. Morrison, I ndebted for the following record of this well:—

| | | |
|---|---|---|
| Surface | 233 | feet. |
| Sand rock | 18 | " |
| Sandstone and limestone | 150 | " |
| Limestone, dark grey and white | 200 | " |
| " soft, light-coloured | 99 | " |
| Shales, blue and red | 96 | " |
| Limestone, white | 34 | " |
| Shale, blue and red | 225 | " |
| Shale, blue | 200 | " |
| | 1,255 | " |

Kincardine.

*incardine.*—The following record of a well at this point is furnished )r. Sterry Hunt*:—

| | | |
|---|---|---|
| Sand and gravel | 91 | feet. |
| Limestone and hard strata | 509 | " |
| Shale, red | 23 | " |
| " blue, with red bands | 117 | " |
| Limestone | 30 | " |
| Shale, blue and red | 125 | " |
| Rock salt | 14 | " |
| | 909 | " |

nother given by Mr. Lionel Smith † was that of a well sunk by ›rs. Gray and Scott. This well was completed in 1873, at a depth 007 feet, as follows:

| | | |
|---|---|---|
| Surface | 89 | feet. |
| Sandstone and limestone, alternate layers | 28 | " |
| Limestone | 179 | " |
| Sandstone, white, fine grained | 29 | " |
| Limestone, dark coloured | 276 | " |
| Shale, red | 14 | " |
| " blue | 115 | " |
| Limestone, hard blue | 164 | " |
| "Cherty rock" | 5 | " |
| Rock salt | 12 | " |
| Shale, blue, clay and salt in alternate layers | 36 | " |
| Rock salt | 60 | " |
| | 1,007 | " |

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* Geol. Sur. of Can., Rept. of Progr., 1866-69.
† Ibid., 1874-75, p. 286.

## WELLS IN PERTH COUNTY.

Three wells were sunk for salt in this county, at Dublin, Mitchell and Listowel, respectively, in none of which places, however, was the venture successful, brines of a low degree of saturation only being obtained, nor was rock salt noted.

Dublin.

*Dublin.*—This well, sunk in 1873, reached a depth of 1,396 feet. No record was kept of the operation, and the only facts ascertained are that, beneath a surface covering of about seventy-five feet, limestone, having a thickness of 520 feet, was pierced. At 600 feet gypsosaliferous marls were met with, after passing through which the Niagara limestone was reached.

Mitchell.

*Mitchell.*—At this place a boring was made of which Mr. Lionel Smith, writes as follows* :—

" At Mitchell, eleven miles south-east of Seaforth, a well was bored to 2,008 feet. After passing through shales belonging to the base of the Onondaga formation, the Niagara limestone was reached, and at 1,570 feet, red shale 300 feet thick, belonging to the Medina formation."

Listowel.

*Listowel.*—Some years ago a well was drilled at Listowel for salt by Mr. John McEwen, late of Goderich. The boring attained a depth of 1,200 feet, when, having reached a point below the usual salt horizon, the well was abandoned. Further data are not at hand beyond the fact that a copious supply of brine of a very low degree of saturation was encountered, though at what depth was not stated.

### *Well at St. Mary's.*

St. Mary's.

A well was sunk at this place about the year 1863 which reached a depth of about 700 feet. At this point small traces of petroleum were said to have been observed. But little information has been obtained of this well, the only reliable data available being some notes by Dr. Sterry Hunt. † The bore was begun on the Corniferous limestone which outcrops at this place, and specimens were obtained from various points between 100 and 500 feet ; these were found in every instance to be magnesian limestones approaching, at times, pure dolomites.

### *Well at Stratford.*

Stratford.

During 1890 a well was sunk at this place in search of gas by the Stratford Natural Gas Company, a company composed principally of citizens of the place, and of which Mr. Jas. Trow, M.P., was president. The drilling reached a depth of 2,386 feet without finding gas. Data regarding the rocks pierced are not at hand, the only information available being the fact that the Trenton limestone was struck at 2,360 feet and that salt water in considerable quantity was found at 2,384 feet, or twenty-four feet below the summit of the Trenton.

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* Geol. Surv. of Can., Rept. of Progr., 1874-75, p. 288.

† Ibid., 1866, p. 249.

## WELLS IN LAMBTON COUNTY.

It is not the intention to enter into the history or the extent of drilling operations in this county nor to enlarge upon the fact of its being and having been the only oil producing territory of the Dominion, but to give merely a brief account of some of the most typical and more important wells sunk.

The oil of Lambton county is, in the main, obtained from two distinct pools known as the Oil Springs and Petrolea fields, both in the township of Enniskillen. The larger of the two—the Petrolea field—with an approximate area of twenty-six square miles, extends W.N.W. about nine miles and E.S.E. about four miles from the village of Petrolea; while the Oil Springs field covers about two square miles and includes the south-eastern part of the village of Oil Springs. The pools are divided by a very distinct synclinal structure, the upper beds of the Hamilton being overlain by the black pyroschists of the Portage formation; these black shales have at Oil City, between Petrolea and Oil Springs, a thickness of forty feet, immediately beneath which is found the upper limestone of the Hamilton series.

### *Wells at Petrolea.*

Petrolea.

The oil horizon of Petrolea lies at a depth of from 450 to 480 feet beneath the surface of the main part of the town, the oil being pumped in all instances from what is known as the "lower vein" at a point about sixty-five feet in the Corniferous limestone. The following record may be taken as typical of the wells sunk in the Petrolea field.

*Well sunk near Imperial Refinery, Petrolea* :—

| | | |
|---|---|---|
| Surface | 104 feet. | |
| Limestone (upper lime) | 40 " | Hamilton. |
| Shale (upper soapstone) | 130 " | |
| Limestone (middle lime) | 15 " | |
| Shale (lower soapstone) | 43 " | |
| Limestone (lower lime) | 68 " | |
| Limestone, soft | 40 " | Corniferous. |
| " grey | 25 " | |

Numerous deeper wells have been sunk in the expectation of finding deeper seated oil, unfortunately, however, in all cases proving to be failures, as no further oil-bearing rocks were found below those from which the present supply is drawn. The most important, on account of its greater depth, is undoubtedly that sunk near the Imperial refinery and known as the "Test Well," of which the following record has kindly been furnished by the driller, Mr. E. Rawlings:

*"Test Well," Petrolea.*

| | | | |
|---|---|---|---|
| Surface | 104 | feet. | |
| Limestone | 40 | " | Hamilton. |
| Shale | 130 | " | |
| Limestone | 15 | " | |
| Shale | 43 | " | |
| Limestone | 68 | " | |
| " soft | 40 | " | Corniferous. |
| " grey | 25 | " | |
| " " | 135 | " | |
| " hard, white | 500 | " | With hard streaks of sandstone from 2 to 5 feet in thickness. |
| Gypsum | 80 | " | Onondaga. (Including the Oriskany, if present.) |
| Salt and shale | 105 | " | |
| Gypsum | 80 | " | |
| Salt and shale | 140 | " | |
| Total depth | 1,505 | " | |

Elevation above tide, 667 feet.

*Wells at Oil Springs.*

Oil Springs. The following record may, in the same way, be taken as illustrating the wells of the Oil Springs pool:—

(East side of field.)

| | | | |
|---|---|---|---|
| Surface | 60 | feet. | |
| Limestone (upper lime) | 35 | " | Hamilton. |
| Shale (upper soapstone) | 101 | " | |
| Limestone (middle lime) | 27 | " | |
| Shale (lower soapstone) | 17 | " | |
| Limestone (lower lime) | 130 | " | |

(West side of field.)

| | | | |
|---|---|---|---|
| Surface | 80 | feet. | |
| Shale (upper soapstone) | 116 | " | Hamilton. |
| Limestone (middle lime) | 27 | " | |
| Shale (lower soapstone) | 17 | " | |
| Limestone (lower lime) | 130 | " | |

Oil is found in both of these wells at 370 feet from the surface, or about sixty feet below the summit of the Corniferous limestone. Salt water occurs in each at 252 feet, beneath which point they are comparatively dry.

Of deep wells sunk in the Oil Springs field, no data are available beyond those found in the report of Dr. Sterry Hunt* wherein he writes :—"At Oil Springs, on the second range of the same township (Enniskillen) we may cite a well on lot 19 which gave clay 42 feet, shale, etc., 182 feet, at which depth a copious flow of oil was obtained. After this became exhausted, the boring was continued for 595 feet further, through limestone, of which the inferior portion was tender and friable. Specimens from the bottom, and from fifty feet above, were found to be a granular dolomite, though regarded by the borers as sandstone. Another boring at Oil Springs, known as the "Test Well," was sunk in lot 18 of the second range, to a depth of one thousand feet. From the record it appeared that there were found, clay 77 feet, grey shale, etc., 300 feet, below which only hard rock was found, until near the bottom, when soft shales were again met with. In this well, small portions of oil were said to have been found by the sand-pump, at depths of 210 and 400 feet in the solid rock beneath the shales." Numerous descriptions of shallow wells, throughout this territory, may also be found in the above-mentioned report.

Operations have been carried on continuously since the sinking of the first deep well in Oil Springs by Mr. James Shaw, in 1862. During the first few months after the discovery of oil, wells of enormous capacity were struck, reaching in the case of the Black and Matthewson a daily flow of 7,500 barrels, other large wells being the Fiero, Swan, Webster and Shepley, Petit, and many others, a list of most of which will be found in Dr. Alexander Winchell's "Sketches of Creation." *Appendix, Note VIII.*

In a personal letter from Mr. Isaac Waterman, of Petrolea, I am informed that there are in the oil territory of Enniskillen township between 2,700 and 3,000 wells pumping and affording oil, the total output from which amounts to about 600,000 barrels of 35 imperial gallons per annum.

### *Well at Wyoming.*

Eight miles to the north of Petrolea a well was sunk on lot 15 of the 1st range of the township of Plympton, near the village of Wyoming, of which the following record was obtained :— Wyoming.

---

* Geol. Surv. of Can., Rept. of Progr., 1866, p. 246.

| | | | |
|---|---|---|---|
| Surface | 104 | feet. | |
| Black shale | 4 | " | Portage. |
| Limestone | 40 | " | Hamilton. |
| Shale | 130 | " | |
| Limestone | 15 | " | |
| Shale | 43 | " | |
| Limestone | 68 | " | |
| " soft | 40 | " | Corniferou |
| " grey | 36 | " | |

Only small quantities of oil were noted accompanied by a copio of saline water.

Elevation above tide about 697 feet.

No records of other wells in this township have been re though from information obtained from the drillers it is learne none of the many borings made were of economic importance.

*Well at Kingstone's Mills.*

Kingstone's Mills.

In the township of Warwick, which lies east of Plympton wells were sunk, notably that at the Elarton salt works, reached a depth of 1,400 feet, terminating in a hard rock, known character. Salt was found, it is said, at 1,200 fee tinuing, interstratified with shale, for 130 feet or to a total d 1,330 feet, beneath which there was a hard rock (pr dolomite) seventy feet thick.

Another well, of which the following is, according to Dr. Hunt, the record, was also sunk at or near this place :—

| | | | |
|---|---|---|---|
| Clay | 14 | feet. | |
| Black shale | 50 | " | Portage. |
| Shales, soft and limestone | 396 | " | Hamilto |
| Limestone, hard | 44 | " | Cornifer |

Dr. Hunt speaks of this well* as being important in showi thickness, in Ontario, of the middle and upper Devonian. To t feet of soft shales and limestone of the Hamilton formation above, he adds 213 feet of rocks of the Portage formation, kn exist through a boring made at Corunna, on the St. Clair making a total of 609 feet.

*Wells in Township of Bosanquet.*

Bosanquet, Port Franks.

The deepest well in this township is that at Port Franks whi sunk by Mr. Joseph Williams who for many years has used the obtained therefrom in the manufacture of salt. The boring is particularly remarkable owing to the great thickness of drift deposits traversed before reaching bed rock. The record, according to Mr. Williams, is as follows :—

---

* Geol. Surv. of Can., Rept. of Progr., 1866, p. 247.

| | | |
|---|---|---|
| Fine sand | 60 | 260 feet. |
| Gravel | 16 | |
| Clay and gravel | 178 | |
| Gravel | 6 | |
| Limestone | | 940 " |
| Shale | | 45 " |
| Salt and shale | | 110 " |

The limestone will probably include the lower part of the Hamilton the whole of the Corniferous and that part of the Onondaga overlying the salt beds. This supposition is borne out by the fact that, at 365 feet from the surface, or 105 feet in the rock, the driller reports having passed through four or five feet of soft marl-like beds ("soapstone"?) which would be utterly unlike the hard grey limestone so characteristic of the Corniferous, and at a point too high to allow of their belonging to the Onondaga formation. Elevation of well above tide, 590 feet.

Widder.

Arkona.

Grand Trunk well.

Of other wells in this township Dr. Sterry Hunt, writes*:— "Another at Widder station, in Bosanquet, gave: clay, 34 ; soft shale, etc., 196 ; limestone, 120 = 350 feet. At 196 feet from the surface, some gallons of oil were obtained. A well, on the southern line of the township, on the third lot, not far from Arkona, was sunk in a valley, which showed, above the boring, the strata of the Hamilton shales, nearly as follows, in descending order : hard limestone, 8 ; shale, 40 ; limestone, 3 ; shale, 9 ; from which point a boring was carried 224 ; hard white limestone, yielding some oil, 18 = 242 feet, in August last. This shows 284 feet of the Hamilton formation at this point. To the west of this, at what is called the Grand Trunk Well, on the twelfth lot of the tenth range of Bosanquet, after clay 90, hard black shale 95, 350 feet of soft shales were said to have been found = 535 feet, and the boring from this depth was in a very soft grey calcareous marl resembling the strata of the Hamilton : neither this nor the well near Arkona, however, represents the entire thickness, in the vicinity of the soft grey shales and so called soapstones of the Hamilton formation, which at Kingstone's Mills, in Warwick, measure, as we have seen, 396 feet, while in the valley of the Thames, as shown above, these strata do not measure over 250 or 290 feet, showing a rapid thickening to the northward."

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*Geol. Surv. of Can., Rept. of Progr., 1866, p. 248.

### *Wells in Township of Brooke.*

Brooke.

Operations were also carried on in this township, unfortunately however, without finding oil in economic quantities. No records hav been kept of the work.

### *Wells in Township of Euphemia.*

Euphemia.

In late years some forty wells have been sunk in this township an small quantities of oil shipped. The field is small and the larges flow from an individual well (the Wilson and Bennett) has been bu one barrel per day. The record of this well is as follows :—

| | | |
|---|---|---|
| Surface | 53 feet. | |
| Shales, etc | 224 " | Hamilton. |
| Limestone | 93 " | Corniferous. |

Another, the Parson's well, gave the following section :—

| | | |
|---|---|---|
| Surface | 58 feet. | |
| Shales, etc | 265 " | Hamilton. |
| Limestone | 37 " | Corniferous. |

No oil was found, the only product being salt water, which w struck in a heavy flow at 360 feet.

All the oil from this field is shipped by Grand Trunk Railway fr Newbury station, the greater part being consigned to London, Onta where it is refined.

### *Wells in Township of Dawn.*

Dawn.

Explorations for oil have been carried southward from Oil Spri into this township, though with poor results. Of the many w sunk, one record alone is available, namely, that on lot 32, conces 10, which reached a depth of 700 feet, and for which I am indebte the driller, Mr. W. Harris, of Petrolea, who reports as follows :—

| | |
|---|---|
| Surface | 50 feet. |
| Shale, black | 70 " |
| Limestone | 70 " |
| Shale and limestone | 285 " |
| Limestone | 225 " |

The "middle lime," which is not shown in the record, consis according to the driller, of about two feet of soft limestone, thoug what depth I was unable to ascertain. The driller also states t throughout the 285 feet of shales he noted several "streaks" of li stone from two to four feet thick.

No oil was obtained in this boring, and salt water was struc 625 feet.

Mr. Lionel Smith states* that he was informed that Mr. Peter McEwen, when boring for oil in this township, had struck rock salt at 1,100 feet. I have been unable to discover where this well is or any further data regarding it.

*Wells in the Township of Sombra.*

Sombra.

No records are at hand of wells bored in this township, though it is supposed that considerable exploratory work has been done. Dr. Sterry Hunt writes† of the work done in this township :—

"Several wells sunk along the Sydenham river, in the townships of Sombra and Camden, present a considerable thickness of black shales overlying the soapstone, or grey Hamilton shales. One, on the north branch of the Sydenham, on the twelfth lot of the seventh range of Sombra, not more than ten feet above the river level, was sunk through 112 feet of quaternary clays, and then through 100 feet of black shale; after which it had, at the time of my visit in August last, been carried a little over 100 feet in the soapstone. Similar results were obtained in a well on an adjoining lot, while another on lot twelve, of the tenth range, gave, below 120 feet of clay, twenty feet of black shales, followed by sixty feet of soap stone at the time of my visit."

Port Lambton

A salt block has been erected at Port Lambton on a well the depth of and information regarding which I have been unable to obtain.

*Wells in Township of Moore.*

Moore.

As in the case of the other townships surrounding Enniskillen, boring operations have been carried into this township in anticipation of an extension of the Petrolea and Oil Springs pools, unfortunately, however, with but slight success. Of the many wells sunk the records of but two are available, viz., a well on lot twenty-eight of the first range, at the village of Corunna, and that of the Courtright Salt Company.

Corunna.

Of the former the following has been preserved : —

| | | | |
|---|---|---|---|
| Clay | 54 | 120 feet. | Surface deposits. |
| Shingle of black shale | 56 | | |
| Clay | 10 | | |
| Shale, black | 8 " | | Portage and Chemung. |
| Sandstone, greenish | 20 " | | |
| Shale black, with pyrites | 185 " | | |
| Grey shale and lime | 17 " | | Hamilton. |

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* Geo. Surv. of Can., Rept. of Progr., 1874-75, p. 288.

† Ibid., 1866, p. 244.

What the results of the boring were is not stated, though it is presumed oil was not found.

Courtright.

*Courtright.*—At the works of the Courtright Salt Co. a well was sunk in June, 1884, to a depth of 1,665 feet. The following record of it has been kindly furnished by the driller, Mr. E. Rawlings, of Petrolea:—

| | | | |
|---|---|---|---|
| Surface (sand, etc.) | 132 | 160 feet. | |
| Hard-pan | 28 | | |
| Shale, black | 32 | " | Portage. |
| Limestone | 40 | " | Hamilton. |
| Shale and limestone | 310 | " | |
| Limestone, white | 50 | " | |
| " grey | 100 | " | Corniferous. |
| " white, hard | 370 | " | Onondaga, including lower part of Corniferous. |
| Sandstone* | 32 | " | |
| Limestone | 400 | " | |
| " and gypsum | 136 | " | |
| Salt | 22 | " | |
| Gypsum | 13 | " | |

**Probably dolomite.*

Elevation above tide, 588 feet.

Salt water was met with at 680 feet, which was effectually cased off, by casing to a depth of 740 feet. A considerable quantity of gas was met with in a few feet of quicksand immediately underlying the "hard-pan." This was thought to be of such importance that a drive pipe was afterwards sunk near the salt well, and the gas utilized until cut off shortly after, when nearly exhausted, by the filling of the casing with sand and water.

### *Wells in Township of Sarnia.*

Sarnia.

The productive oil territory of the Petrolea pool extends into the south-eastern corner of this township, in which part many successful wells have been and are being sunk. The records of none of these are available, though it is supposed that they would not differ much from those of wells nearer to Petrolea, and that typical of the Petrolea pool.

Simpson's Farm.

In the south-western part of the township several wells have been sunk, from which considerable flows of gas are recorded. Of one of these, on J. D. Simpson's farm, lot 15, block A, Indian reserve, the following has been obtained:—

| | | | |
|---|---|---|---|
| Surface | 124 | feet | |
| Shale, with hard streaks | 32 | " | Portage. |
| Shale and limestone | 324 | " | Hamilton. |
| Limestone | 15 | " | |

At 480 feet gas was found accompanied by oil and salt water; e flow of gas being estimated at about 20,000 cubic feet per diem.

*Wells in Town of Sarnia.*

Sarnia.
King's grist-mill.

In the town of Sarnia are several wells, prominent among which is at at King's Grist-mill, drilled in 1875 by Mr. E. Rawlings, of trolea, to whom I am indebted for the following record :—

| | | | |
|---|---|---|---|
| Surface sand | 9 | 120 feet | |
| Blue clay | 109 | | |
| " Hard-pan " | 2 | | |
| Shale, black | 36 | " | Portage. |
| Limestone | 30 | " | Hamilton. |
| Shale | 263 | " | |
| Limestone | 5 | " | |
| Shale | 40 | " | |
| Limestone | 60 | " | |
| " grey | 100 | " | Corniferous. |
| " hard | 546 | " | Onondaga, including lower part of Corniferous. |
| " hard and flinty | 200 | " | |
| " with gypsum | 105 | " | |

Elevation above tide, 589 feet.

resh water was encountered at 120 feet beneath the " hard-pan " a copious flow of salt water at 654 feet ; the casing, however, was ied to only 495 feet or just into the lower limestone of the milton. Oil was not observed, but gas in small quantities was nd at 400 feet and cased off.

Peterson's well.

*eterson's well.*—During 1887, Messrs. N. C. Peterson and Sons led at their works in the town for the purpose of obtaining a supply as for their boilers. The drilling was carried to a depth of 685 feet, which two small flows of gas were obtained at 330 and 515 feet, the er affording the greater supply. According to the driller, Mr. H. tchell, the log is as follows :—

| | | | |
|---|---|---|---|
| Surface | 200 | feet. | |
| Shale, black | 15 | " | Portage. |
| Limestone | 150 | " | Hamilton, including upper part of Corniferous. |
| Shale | 85 | " | |
| Limestone | 5 | " | |
| Shale | 60 | " | |
| Limestone | 170 | " | |

In the last few feet bored there was a heavy flow of salt water ich rose to a considerable height, flooding the gas-rock. The ell was not packed, and after supplying fuel for some time to the iler at the works, was finally abandoned.

Agricultural works well.

*Agricultural Works Well.*—This well, also drilled by Mr. Mitchell, gave the following record :—

| | | | |
|---|---|---|---|
| Surface | 130 | feet. | |
| Shale, black | 80 | " | Portage. |
| Limestone | 80 | " | |
| Shale | 160 | " | |
| Limestone | 5 | " | |
| Shale | 60 | " | |
| Limestone | 150 | " | |
| Depth | 665 | " | |

Gas in small quantities was found at 515 feet, and salt water at 645 feet. The casing was carried to a depth of 140 feet, and the hole plugged at 640 feet, but owing to the water being ineffectually shut off the gas was never available and the well was finally abandoned.

Dickens we

*Dickens Well.*—Possibly the most important of the wells in Sarnia is the Dickens Well, sunk in the southern part of the town, near the corner of Rose and Tecumseh streets. It also was sunk by Mr. Mitchell, who furnishes the following record :—

| | | | | |
|---|---|---|---|---|
| Surface | 130 | 200 | feet. | Surface deposit. |
| Hard-pan | 55 | | | |
| Gravel | 15 | | | |
| Limestone | | 90 | " | Hamilton. |
| Shale | | 100 | " | |
| Limestone | | 5 | " | |
| Shale | | 68 | " | |
| Limestone | | 77 | " | |

Gas was found in the lower shale at 473 feet, affording about 20,000 cubic feet per diem. This was used in the lighting of several private dwellings and street lamps in the immediate neighbourhood. The boring may be considered dry, no casing below the conductor being necessary.

### WELLS IN KENT COUNTY.

Many wells have been drilled throughout this county in search of both gas and oil, principally during the years following immediately upon those marking the discovery of oil in large quantities in the Petrolea and Oil Springs pools. From none of these borings, however, has much oil been obtained, though found in many of them. Again, in later years, considerable energy has been evinced in sinking wells for gas, so far unsuccessfully, as only small quantities have been found, nowhere sufficient to warrant further trial.

ɔring was first begun along the banks of the Sydenham river, and ations were carried on actively on lines gradually receding north south from tho river banks, till about 1867, when operations ɜd. Since the finding of gas in large quantities near Kingsville, x county, drilling for gas has been indiscriminately carried hroughout the county. Unfortunately data regarding all these ıot at hand, and it has therefore been found impossible to correlate :ecords received, with the rocks shown to exist by more correct

### *Wells at Bothwell.*

**Bothwell.** f the many wells sunk in and around the village of Bothwell in township of Zone, only few records are available; among others of the Clinton Oil Well. This, drilled in 1865 or 1866, reached ɜpth of only 370 feet, at which point a small show of oil is rted. The record is as follows :—

| | |
|---|---|
| Surface | 155 feet. |
| Soapstone | 31 " |
| Shale, black | 4 " |
| Soapstone | 32 " |
| Limestone | 148 " |

levation above tide about 691 feet.

f another well near Bothwell, Dr. Sterry Hunt gives the following rd* :—

| | | |
|---|---|---|
| Sand | 25 | 90 feet. |
| Blue clay | 45 | |
| Boulder clay | 20 | |
| Shale, black | | 77 " |
| Soapstone, etc. | | 193 " |
| Limestone | | 120 " |

gain, in the same report, Dr. Hunt describes other borings as ws : † " At Bothwell, one boring gave clay 90, shale, etc., 270, after h the well was sunk 120 feet in solid limestone, without yielding ɜr oil or gas. Another, the Empire well, was sunk through clay feet, shale 160 feet, after which oil was reached at a distance of feet in the limestone. In another, the Pepper well, after about same depth of clay, oil was found in great abundance at 210 feet ıe rock, while the Chambers well gave a copious supply of oil at a h of 385 feet from the surface. The Thames well was sunk to feet, but met with a copious supply of salt and sulphuric water, some oil, at 475 feet."

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[*] Geol. Surv. of Can., Rept. of Progr., 1866, p. 245.

[†] Ibid., p. 247.

## *Wells in Camden and Chatham Townships.*

Camden and Chatham.

Dr. Hunt writes as follows of several wells sunk in the townships of Camden and Chatham :* "A well on lot eight of the second range of Camden offered clay 53, black shale 200, and soapstone, etc., 167 = 420 feet. Another, on the seventh range of Chatham, on the line of Camden, gave clay 48, black shale 100, soapstone, etc., 252, limestone 195 = 595 feet. One on lot six of the fourth range of Camden gave clay 33, black shale 98, soapstone, etc., 229, limestone 55 = 415 feet. Another, on lot two of range five of the same township, clay 50, black shale 146, soapstone, etc., 202, limestone 161, sandstone 10 = 569 feet."

Another well, drilled more recently, on lot 3, concession 2, Camden, gave, according to the driller, Major Savage, of Petrolea:—

| | | |
|---|---|---|
| Sand | 13 | 60 feet. |
| Clay | 40 | |
| "Hard-pan" | 7 | |
| Shale, black | | 20 " |
| Limestone | | 30 " |
| Soapstone | | 204 " |
| Limestone | | 117 " |
| Sandstone | | 46 " |
| Hard rock (limestone) | | 23 " |
| Depth | | 500 " |

Salt water in considerable quantity was noted at 431 feet; neither oil nor gas was found.

## *Wells at Thamesville.*

Thamesville.

Of the wells in the neighbourhood of Thamesville, Dr. Hunt writes as follows† :—" At Thamesville, about a mile north from the railway station, a well was sunk through clay 60, grey shale, etc., 240', grey limestone 32' = 332 feet. At a depth of sixteen feet in the limestone oil was met with, and the well, at the time of my visit—in October, 1866—had yielded some thirty barrels, which had been dipped out, the well not having yet been pumped. Another well adjoining the railway station was sunk 615 feet without yielding oil. It gave clay 76', grey shales, etc., 207', the remainder being harder strata, of which the first 186 feet were described as hard limestone."

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*Geol. Surv. of Can., Rept. of Progr., 1866, p. 244.

†Ibid., p. 247.

### *Well at Dresden.*

Dresden.

During 1888, a well was sunk in the village of Dresden by Major avage, of Petrolea, who has kindly furnished the following record:—

| | | |
|---|---|---|
| Surface | 43 | feet. |
| Shale, black | 180 | " |
| Limestone | 12 | " |
| Soapstone | 172 | " |
| Limestone | 75 | " |
| Sandstone | 44 | " |
| Limestone, hard | 79 | " |

What the economic results were was not stated.

### *Wells at Chatham.*

Chatham.

Reference is again made to Dr. Hunt's report for information garding a boring at Chatham. This reached a depth of 1,000 feet, which the first seventy feet consisted of clay, followed by soft shaly cks for 294 feet, including near the base, or at about 360 feet from the rface, six feet of black shale. According to Dr. Hunt*: "After this ard limestone was encountered in which, at a depth of 58 feet, a ein of salt water, with some oil, was found. Still lower, at about 00 feet from the surface, a copious source of sulphurous water was ruck, which continued to flow for some months, filling a pipe of ½ inches until stopped by a plug driven into the bore."

Another well was drilled, during recent years, about one mile north-est of the Grand Trunk Railway station at Chatham, which reached depth of 1,000 feet, as follows:—

| | | | |
|---|---|---|---|
| Surface clay | 60 | feet. | |
| Shale, black | 118 | " | Portage. |
| Soapstone | 200 | " | |
| Limestone | 18 | " | |
| Soapstone | 37 | " | |
| Limestone | 567 | " | |

Casing was only carried to a depth of 260 feet, and a heavy flow of salt water was struck at about 700 feet. A small "show" of oil was noted at 475 feet. Elevation above tide, 583 feet.

### *Well at Charing Cross.*

Charing Cros

It is reported that a well was drilled here to a depth of 700 feet, in which a small "show" of gas was noted, though at what depth was not stated.

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*Geol. Surv. of Can., Rept. of Progr., 1866, p. 247.

### *Wells in Harwich Township.*

Harwich.

On lot 9, concession 4, township of Harwich, a well was drilled, prior to 1866, of which the following record is given :—

| | | | |
|---|---|---|---|
| Clay | 163 | feet. | |
| Shale | 17 | " | Portage. |
| Shale, black | 58 | " | |
| Soapstone | 192 | " | Hamilton. |
| Limestone | 70 | " | |

What the results of the boring were is not stated.

Elevation, above tide, 634 feet.

Rondeau.

*Rondeau.*—A well at Rondeau, in the township of Harwich, is thus described by Dr. Hunt* :—" At Stoddard's Mills, at the Rondeau, and near the level of the lake, the clay was 104, followed by about 60 feet of black shale, and 200 feet or more of soapstone with layers of black shale, below which the well was sunk in limestone to a total depth of 520 feet. No correct record of the boring of this well had been kept, but this approximate statement was obtained from what seemed a trustworthy source."

Harwich.

*Near Harwich.*—I am indebted to Mr. Richard Ransford, of Clinton, for the following record of a well drilled for oil on the line between Howard and Harwich townships, and near the village of Harwich. No oil was found :—

| | | |
|---|---|---|
| Surface | 78 | feet. |
| Shale, black | 60 | " |
| " white | 23 | " |
| Soapstone | 10 | " |
| Limestone, white | 15 | " |
| Shale | 70 | " |
| Limestone, grey | 20 | " |
| Shale, white | 100 | " |
| Soapstone | 20 | " |
| Limestone, white | 24 | " |
| Shale, white | 20 | " |
| Limestone, white | 5 | " |
| " grey | 110 | " |
| " blue | 15 | " |

### *Well at Blenheim.*

Blenheim.

During 1890 a well was drilled at this place by a company composed chiefly of citizens of the place under the title of "The Citizens Gas pany." The depth reached was 900 feet, where the tools stuck the hole was abandoned. Gas in small quantities is said to e been found at 700 and 800 feet.

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* Geol. Surv. of Can., Rept. of Progr., 1866, p. 245.

as is said to have been found in a shallow well on the farm of Wm. d, in concession 7 of Harwich, and about three miles and a-half n Blenheim. Sufficient is said to be obtained for heating and ting that gentleman's house.

### *Wells in Howard Township.*

well in concession 4 of Howard on the line of Orford township escribed in the Geological Survey Report,* and the following record n :— **Howard.**

| | |
|---|---|
| Clay | 95 feet |
| Soapstone and light shales, with a black band near the base | 255 feet |
| Limestone, bluish | 160 " |
| Limestone, grey, sandy | 197 " |
| Depth | 707 " |

### *Wells in Orford Township.*

*avey Well.*—This was drilled during 1890 by Messrs. Hiram ker and Sons, of Walkerville, to whose driller, Mr. J. S. Hyland, I indebted for the logs of both this and the Grant well. The ing was made on lot 10, concession 11, Orford township, on the ey farm, and reached a depth of 1,000 feet as follows :— **Orford, Ravey well.**

| | |
|---|---|
| Surface | 160 feet |
| Broken limestone | 81 " |
| Shale, white | 70 " |
| Limestone, grey | 90 " |
| Limestone, pink | 154 " |
| "Sandstone," fine white | 30 " |
| "Sandstone," grey | 45 " |
| Limestone, grey | 285 " |
| "Sandstone," fine | 85 " |

he well was, in the upper part, comparatively free from water, small seams being found to a depth of 630 feet where a ng flow of sulphur water was struck, and cased off, the casing rwards being carried to a depth of 915 feet. At 965 feet a heavy of salt water was struck which rose to 100 feet from the surface, where it now stands. Gas was not noted, but a “shov oil was reported at 470 feet.

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* Geol. Surv. of Can., Rept. of Progr., 1866, p. 245.

Elevation, above tide, 740 feet.

Grant well.

*Grant Well.*—This was drilled by the same firm as the precedin the Grant farm, lot 23, concession 14, Orford township, and rea a depth of 500 feet, of which the following record was obtaine

| | |
|---|---|
| Surface | 240 feet |
| Broken limestone | 10 “ |
| Limestone, pink and grey | 140 “ |
| Limestone, white | 20 “ |
| “ Sandstone,” fine grey | 30 “ |
| “ Sandstone,” and limestone, grey and white | 60 “ |

No gas was found; oil accompanied by water was struck in quantities at 318 and 410 feet. Sulphur water was encountered in siderable quantities at several points, the greatest flow being fror lower sixty feet.

Elevation above tide, 691 feet.

It is to be regretted that specimens of drillings were not obt from these two wells as the records furnished to this office afford information regarding the rocks traversed.

## WELLS IN ESSEX COUNTY.

The history of gas explorations throughout this county is what recent, and may be considered as beginning during Decei 1888, with the Coste Well No. 1, which had a measured flo 10,000,000 cubic feet per day. Since that date about twent wells have been sunk in search of gas, but in only one instance success, namely, in the case of the boring made by the King Natural Gas and Oil Association, known as Citizens' No. 2, whicl a daily flow of 7,000,000 cubic feet. The drilling of this latter was the cause of considerable litigation between its owners an Ontario Natural Gas and Fuel Company, the owners of the Coste 1. The right to bore on the road allowances of the municipality granted by the county council to the Kingsville Citizens Company at once commenced drilling on the high road some fifty-five yards of the Coste No. 1; an injunction was taken out by the propriet the latter, who were, however, eventually unable to restrain the c tions. Except in these two wells all efforts to find gas in p quantities have been unsuccessful, and many thousands of d have been spent, and the gas obtained has hitherto only been us light the streets of the village of Kingsville.

While drilling for gas on what is known as Walker's Marsh, c what was at first thought to be paying quantities, was found

o. 2

ral wells were drilled both by Messrs. Walker and Sons, of Walker-
e, and the Union Gas Company. It was found, however, that the
ntity of oil available in any one well nowhere exceeded three bar-
per day, and was accompanied by so much salt water that opera-
s were discontinued.

am unable to give the records of most of the wells in this county,
although specimens are at hand from several, they have not yet been
ely examined; suffice it to say that the oil and gas horizon is near
summit of the Clinton or base of the Niagara formation.

### *Wells in Tilbury Township.*

hree wells have been sunk in this township, near Comber, and are Tilbury.
wn as numbers 1, 2 and 3 respectively. Of No. 1 no data are
ilable, and it is understood that through some defect it was not
epted from the contracting driller.

o. 2.—Is on lot 7, concession 5, Tilbury West. It was Comber, No. 2
led for Mr. M. J. Woodward, of Petrolea, to a depth of 1,280 feet.
1,213 feet a small quantity of oil was found, several barrels of
ich were shipped to the proprietors' refinery at Petrolea.

he record of drilling as supplied by the driller is as follows :—

| | | |
|---|---|---|
| Surface | 120 | feet. |
| "Hard rock" (limestone?) | 53 | " |
| Limestone, white | 110 | " |
| Sandstone | 20 | " |
| Limestone | 200 | " |
| Sandstone | 10 | " |
| Limestone, soft | 76 | " |
| " hard | 23 | " |
| Sandstone | 35 | " |
| Limestone, soft | 27 | " |
| " hard | 12 | " |
| " soft | 34 | " |
| " hard | 22 | " |
| Shale | 100 | " |
| Limestone, soft | 12 | " |
| " hard | 125 | " |
| " white, with shale | 50 | " |
| Limestone, blue | 10 | " |
| " hard, with shale | 55 | ' |
| "Very hard rock," with pyrites | 20 | " |
| Limestone, hard | 156 | " |
| " | 10 | " |

Casing was carried to a depth of 683 feet effectually shutting off all water. Elevation above tide 604 feet.

Comber, No. 3

*No. 3.*—This well is about half-a-mile west and one mile south of the Michigan Central Railway Station at Comber, and is 1,306 feet deep. It was drilled, for the same gentleman as the preceding, by Mr. J. R. Minhinnick, of London, Ont., to whom I am indebted for the following :—

| | | |
|---|---|---|
| Surface (clay) | 124 | feet. |
| Limestone | 136 | " |
| " white | 100 | " |
| Sandstone | 10 | " |
| Limestone, in alternate soft and hard layers | 370 | " |
| Shale, with streaks of hard lime | 100 | " |
| Limestone | 135 | " |
| " white, with shale | 50 | " |
| " with shale | 53 | " |
| " hard | 128 | " |
| " very hard | 100 | " |

Unlike the last, no oil was found, and gas in small quantities w found at 260 and 1,078 feet.

Fresh water was found at 150 feet or twenty-six feet in the fir limestone, sulphurous water at 260 feet, and a strong flow of sali water at 1,127. Casing was carried to a depth of 700 feet.

Elevation above tide 600 feet.

### *Wells in Maidstone Township.*

Maidstone, Belle River.

*Belle River.*—Two wells were sunk near this village, both of wh are on lot 12, concession 6, township of Maidstone, at an elevation about eighteen feet above Lake St. Clair, or about 600 feet above t The deepest was 1,465 feet, of which the following record is available

| | | |
|---|---|---|
| Surface, blue clay | 92 | feet. |
| " hard-pan | 3 | " |
| Limestone, blue | 90 | " |
| Shale, dark | 90 | " |
| Sandstone, white | 25 | " |
| Limestone | 925 | " |
| Sandstone (?) grey | 25 | " |
| ? | 215 | " |

Water was first found at 275 feet or at the base of the c shales ; and again, at 1,300 feet, a strong flow of salt water w nd, though no salt beds were pierced. Gas in small quan- es was noted, though at what depth was not stated.

Though no name is given to the strata penetrated below the twenty- feet of sandstone, there is every reason to believe that they con- ed of shale, etc., of Medina age, and that the boring ceased in that mation.

The other well was drilled close to the foregoing and reached a depth 1,010 feet, the record of rocks pierced being practically the same. ater was found under similar conditions and at the same depths; gas s not noted.

### *Well in Anderdon Township.*

**Anderdon, Fraser well.**

Only one well was sunk in this township, viz., "The Fraser Well," illed about one-half mile east of the Detroit river and near the vn line. The well is only 530 feet deep, seventy feet of which con- ted of surface deposits. Fresh water was found at 130 feet, but ither gas nor oil was noted.

### *Wells in Malden Township.*

**Malden.**

During 1889 a company was formed in Amherstburg under the title the "Great South-western Gas and Oil Company, of Amherstburg." is company drilled two wells near the town, viz., "The Colwell ove Well," on lot 2, concession 1, and the "Parks Well," on lot 4, ncession 2, of Malden township, in neither of which was any econ- ic result attained.

I am indebted to Major John Savage, of Petrolea, for records of se two wells, as follows:—

**Colwell Grove well.**

*Colwell Grove Well*—Depth, 1,418 feet.

| | | |
|---|---|---|
| Surface (clay) | 8 | feet. |
| Limestone | 252 | " |
| Sandstone (?) | 60 | " |
| Limestone | 180 | " |
| Shale and gypsum | 16 | " |
| Limestone, hard | 320 | " |
| " soft | 297 | " |
| " | 265 | " |
| Grey shale | 20 | " |

Casing was carried to a depth of 508 feet, or eight feet into the first ale, effectually shutting off all water down to that depth. A heavy w of salt water was found at 1,115 feet, to shut off which no fort was made. Neither gas nor oil was noted.

Parks well.

*Parks Well.*—Depth, 1,004 feet.

| | | |
|---|---|---|
| Surface (sand and gravel) | 30 | feet. |
| Limestone | 228 | " |
| Sandstone (?) | 84 | " |
| Limestone | 182 | " |
| Gypsum | 12 | " |
| Limestone | 468 | " |

The well was cased to a depth of 820 feet ; at 987 feet, a hea
flow of salt water was found accompanied by small quantities of ga

### *Wells in Colchester Township.*

Colchester.

In and about "Walker's Marsh," in this township, several wells w
sunk from which small flows of oil were obtained, the greater quan
being found in Messrs. Walker and Son's wells, Nos. 1 and 2. The s
ply proving to be small, the field has been abandoned.

Walker's No. 1.

*Walker's No. 1.*—This well on lot 8, concession 6, Colchester to
ship, is 1,300 feet deep, terminating in a fine grained brown sa
shale. A small show of oil was noted at 1,000 feet accompanied b
very small quantity of gas. Water was found at 180 feet
again at 1,100 feet ; the latter not being cased off as the casing
only carried to a depth of 600 feet.

The following record has kindly been furnished by the driller,
Hyland :—

| | | | |
|---|---|---|---|
| Surface, clay | 35 | 87 | feet. |
| " sand | 52 | | |
| Limestone, grey | | 113 | " |
| " white | | 70 | " |
| " grey | | 70 | " |
| " grey and white | | 10 | " |
| " brown | | 10 | " |
| " brown and grey | | 5 | " |
| " fine grey | | 5 | " |
| " dark brown | | 270 | " |
| " brown and white | | 20 | " |
| " " | | 10 | " |
| Shale, dark grey, and limestone | | 10 | " |
| Limestone, light pink | | 40 | " |
| " dark pink | | 35 | " |
| " grey | | 75 | " |
| Shale, dark grey and limestone | | 100 | " |
| Limestone, grey and white | | 10 | " |
| " brown and white | | 130 | " |
| " fine white | | 10 | " |
| " and sandstone, brown | | 200 | " |

**Walker's No. 2.**

*Walker's No. 2.*—This well is on lot 11, concession 6, Colchester; and reached a depth of 1,016 feet; the record to this depth is very similar to that obtained of the foregoing. Casing was carried to a depth of 600 feet and sulphurous water accompanied by oil was found at 1,000 feet; this well is said to have pumped five barrels of oil per diem.

**Walker's No. 3.**

*Walker's No. 3.*—This well, on lot 11, concession 5, Colchester, was not, at the time of my visit, completed, though it has been since reported that small quantities of oil and gas were obtained.

### *Union Gas Co.*

**Union Gas Co. No. 1.**

*Well No. 1.*—A syndicate composed of Messrs. P. McLaren, of Perth; N. A. Coste, of Amherstburg; E. Coste, of Buffalo; D. McGillivray, of Port Colborne, and others, under the provisional title of the Union Gas Co., sank two wells between the Walker's marsh series of wells and Essex Centre, unfortunately, however, without success. The first, or No. 1, was drilled on lot 17, concession 7, Colchester, to a depth of 1,175 feet, near the base of the Niagara formation, according to the following record, kindly furnished by Mr. E. Coste:—

| | | |
|---|---|---|
| Surface | 66 feet. | |
| Limestone, white and grey | 169 " | Corniferous. |
| Dolomite and gypsum, with blue black shales towards bottom | 740 " | Onondaga. |
| Dolomites | 200 " | Guelph and Niagara. |

Sulphurous water was found at 582 and 613 feet, which was shut off by casing to a depth of 630 feet. A strong flow of salt water was, however, found at 1,175 feet, on finding which the casing was drawn and the well abandoned.

**No. 2.**

*Well No. 2.*—This well on lot 16, concession 6, Colchester, reached a depth of 1,154 feet, and though twenty-one feet less than the foregoing, was nineteen feet lower in the geological scale, terminating two feet below the summit of the Clinton.

The record furnished by Mr. E. Coste shows:—

| | | |
|---|---|---|
| Surface | 93 feet. | |
| Limestone, white and grey | 92 " | Corniferous. |
| Dolomites and gypsum with blue-black shales towards bottom | 740 " | Onondaga. |
| Dolomites | 217 " | Guelph and Niagara. |
| Limestone | 2 " | Clinton. |

Casing was carried to a depth of 680 feet which was, however, withdrawn on the subsequent abandonment of the well.

Essex Centre. *Wells at Essex Centre.*—A well was drilled during 1889 on lot 283, South Talbot Road, Essex Centre, Colchester, by the Central Gas and Oil Company, of Essex county, of which Mr. John Milne, of Essex, Centre, is president. It reached a depth of 1,200 feet without either gas or oil being noted. Specimens of the drilling were obtained and are now in the Geological Survey office. Considerable flows of water interfered greatly with the operations and necessitated a string of casing 950 feet in length. The first flow of water was found at 130 feet or nineteen feet below the surface of the rock ; this was followed by fresh water seams at 155 and 190 feet, by sulphur water at 310 and 565 feet and salt water at 800 and 1,130 feet.

A well was drilled at Decew's mill for water which was found at 180 feet, or fifty feet below the base of the surface deposits. The depth reached was 209 feet, neither gas nor oil being noted.

Sweetman's Mills. *Premier Oil Company's Well.*—This well was drilled by Mr. R. E. Menzies for the above company on lot 19, concession 9, Colchester North, at Sweetman's mills to the depth of 1,135 feet where salt water was struck ; neither gas nor oil was found.

### *Wells of the Ontario Natural Gas Co. in Gosfield Township.*

Ont. Nat. Gas Co., Coste No. 1. *Coste No. 1.*—This, the first well drilled for gas in the country, afforded about 10,000,000 cubic feet a day. It is on the north-west corner of lot 7, concession 1, and about midway between the villages of Kingsville and Ruthven. Gas was struck at 1,017 feet in a vesicular dolomite, probably of Clinton age. The boring was then continued to 1,021 feet, when the great pressure made it no longer possible to operate the tools. The supply has, unfortunately, never been drawn upon owing to dissensions among the shareholders of the company. Frequent borings have since been made in the vicinity, but nothing of any value has been found, except in the well bored by the Citizens Company of Kingsville, described below as Citizens' No. 2.

Coste No. 2. *Coste No. 2.*—This boring, made by the same company as the preceding, is on the south-west corner of the south half of lot 1, concession 1, township of Gosfield, close to the Lake Erie, Essex and Detroit River Railway Company's station at Kingsville. Beyond the fact that the depth reached was 1,038 feet, no information is at hand, though it is presumed that the rocks pierced are very similar to those in Coste No. 1.

Coste No. 3. *Coste No. 3.*—Was also bored by the same company and is on lot 8, concession 2, Gosfield. No particulars are at hand regarding it except that the depth reached was 1,017 feet, and that up to that point the well was barren of gas or oil, and that salt water was struck in heavy flows near the bottom of the well.

Isaac Wigle well.

*Isaac Wigle Well.*—This was drilled by a syndicate composed of some of the shareholders of the above-mentioned company, and is on lot 5, concession 2, Gosfield. It proved, however, to be practically barren of gas, only small quantities being noted at 1,090 feet, at which depth the drill was about fifteen feet above the beds in which Coste No. 1 finished. The total depth was 1,095 feet, where a heavy flow of salt water was struck. The surface deposits showed a total thickness of 117 feet and the casing was carried 468 feet deeper.

### *Wells of the Citizens' Gas, Oil and Piping Co. of Kingsville.*

Citizens' Gas, Oil and Piping Co.

Three wells in all were drilled by this company, which was incorporated in 1889, with S. A. King as president and J. H. Smart as secretary.

Citizens' No. 1

*Citizens' No. 1.*—This, the first well drilled by the above company, is on lot 3, con. 1, East Division Gosfield South, and is 1,126 feet deep. The boring was begun on the 18th May, 1889, and was not finished, owing to several unavoidable delays, till the 19th of August of the same year. The first water was struck at sixty-eight feet, and was shut off by casing to a depth of 604 feet. Gas in small quantities was obtained at 750 feet, which was, however, interrupted by a heavy flow of salt water between 1,100 and 1,121 feet.

Citizens' No. 2

*Citizens' No. 2.*—This well was drilled on the road allowance of the second concession about 55 yards west of Coste No. 1, and reached a depth of 1,020 feet. No particulars of the boring are at hand beyond the fact that in the vesicular dolomite at that depth a daily flow of gas equal to 7,014,000 cubic feet was obtained. The gas has been piped to Kingsville, a distance of about three miles, where it is being utilized in a small measure by the people of that place. The drilling of this well was the cause of considerable litigation between its owners and those of Coste No. 1, who were, however, finally unable to restrict operations.

That the precedent so established, of allowing mining of any kind to be carried on upon the road allowances of a municipality is bad, cannot be denied. More especially is this so in regard to operations in search of gas or oil, as these minerals are peculiar in their mode of occurrence, and, have not like solids, a fixed position.

**Citizens' No. 3**

*Citizens' No. 3.*—This, the last well sunk by the above company, is on lot 4, con. 1, Gosfield South, it reached a depth of 1,085 feet without affording gas in quantity, a small flow only being noted at 980 feet. Salt water was struck at 1,085 feet, and the well was abandoned.

**Bruner Well.**

*Bruner Well.*—This well was drilled by Messrs. Walker and Sons, of Walkerville, on lot 18, con. 3, to 1,184 feet, a greater depth than was reached in any other boring made in the township. A small show of gas was noted at 1,020 feet, which was, however, cut off by a heavy flow of salt water, struck at a lower point. Casing was carried to a depth of 580 feet.

### *Wells in Mersea Township.*

**Leamington.**

*Well one Mile South of Leamington.*—Regarding a well sunk some years ago near the village of Leamington, Dr. T. S. Hunt writes as follows :—[*]

"On the seventh lot of the first range of Mersea and a mile south of the village of Leamington, a well was sunk through clay 100, limestone 310 = 410 feet without finding either oil or saline water. The rock at 380 feet from the surface was a somewhat magnesian limestone. Indications of oil in the shape of gum-beds or superficial layers of thickened petroleum are said to have been found in this vicinity."

**Leamington Citizens Well.**

*Well at Leamington.*—During 1889 a syndicate of citizens of this place under the title of the Leamington Citizens Natural Gas Company undertook to bore for natural gas in the vicinity of the village and commenced operations on the 10th of May of the same year. The well known as "The Leamington Citizens Well" is on the sout half of lot 5 concession 2, Mersea, a short distance west of the village and alongside the L. E. E. & D. R. Ry. Co.'s tracks. Operations were suspended at 1,030 feet owing to heavy flows of salt water which were never cased off. The surface deposits measured 128 feet in thickness beyond which the casing was carried only twelve feet or 140 feet from the surface. Water was struck at 135, 410, 425 and 500 feet, and gas in small quantity at 965 feet. At the time of my visit the well was full of water and although there was a strong odor of gas at the casing the quantity was not sufficient to indicate any pressure on a Pitot's tube over an aperture bushed to one inch.

**Blytheswood.**

*Well at Blytheswood.*—A well was during 1889 drilled near this place on the north-west corner of lot 7, concession 9, Mersea, presumably by the Standard Oil Company to the depth of about 1,200 feet. From facts gleaned from operators in the district, I understand that a small flow of gas was obtained at 1,050 feet, followed at 1,150 feet by a heavy flow of salt water which was not cased off, the casing being carried to a depth of but 800 feet. Oil was not found.

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[*] Geol. Surv. of Can. Rept. of Progr., 1866, p. 249.

# APPENDIX A.

## TABLE of Beaumé's Hydrometer with Corresponding Specific Gravities.

Table of Gravities.

Temp. 60° Fahr.

| Beaumé. | Specific Gravity. | Beaumé. | Specific Gravity. | Beaumé. | Specific Gravity. | Beaumé. | Specific Gravity. |
|---|---|---|---|---|---|---|---|
| 10 | 1·0000 | 30 | 0·8750 | 50 | 0·7777 | 70 | 0·7000 |
| 11 | 0·9929 | 31 | 0·8695 | 51 | 0·7734 | 71 | 0·6965 |
| 12 | 0·9859 | 32 | 0·8641 | 52 | 0·7692 | 72 | 0·6930 |
| 13 | 0·9790 | 33 | 0·8588 | 53 | 0·7650 | 73 | 0·6896 |
| 14 | 0·9722 | 34 | 0·8536 | 54 | 0·7608 | 74 | 0·6863 |
| 15 | 0·9655 | 35 | 0·8484 | 55 | 0·7567 | 75 | 0·6829 |
| 16 | 0·9589 | 36 | 0·8433 | 56 | 0·7526 | 76 | 0·6796 |
| 17 | 0·9523 | 37 | 0·8383 | 57 | 0·7486 | 77 | 0·6763 |
| 18 | 0·9459 | 38 | 0·8333 | 58 | 0·7446 | 78 | 0·6730 |
| 19 | 0·9395 | 39 | 0·8284 | 59 | 0·7407 | 79 | 0·6698 |
| 20 | 0·9333 | 40 | 0·8235 | 60 | 0·7368 | 80 | 0·6666 |
| 21 | 0·9271 | 41 | 0·8187 | 61 | 0·7329 | 81 | 0·6635 |
| 22 | 0·9210 | 42 | 0·8139 | 62 | 0·7290 | 82 | 0·6604 |
| 23 | 0·9150 | 43 | 0·8092 | 63 | 0·7253 | 83 | 0·6573 |
| 24 | 0·9090 | 44 | 0·8045 | 64 | 0·7216 | 84 | 0·6542 |
| 25 | 0·9032 | 45 | 0·8000 | 65 | 0·7179 | 85 | 0·6511 |
| 26 | 0·8974 | 46 | 0·7954 | 66 | 0·7142 | 86 | 0·6481 |
| 27 | 0·8917 | 47 | 0·7909 | 67 | 0·7106 | 87 | 0·6451 |
| 28 | 0·8860 | 48 | 0·7865 | 68 | 0·7070 | 88 | 0·6422 |
| 29 | 0·8805 | 49 | 0·7821 | 69 | 0·7035 | 89 | 0·6392 |
| .... | ........ | ....... | .......... | ...... | ....... | 90 | 0·6363 |

## APPENDIX B.

COST OF "DRILLING RIG" COMPLETE AT PETROLEA, ONT. F. O. B.

**Cost of drilling rig.**

| | |
|---|---|
| One 20 h. p. boiler and 20 h. p. engine (10 ins. diameter and 14 ins. stroke) | $ 800 |
| One 3½-in. steel counter shaft, 5 ft. long, 4 flanges, crank waist pin, nodale pin, saddle, 2 pair brasses and pitman straps, 2 stirrup and plates, 2 14-in. sheaves for derrick | 90 |
| Wooden wheels and rig spring pole and wrench block | 97 |
| One 12-in. leather belt, 28 ft. long | 25 |
| One 12-in. 5-ply rubber belt, 40 ft. long | 25 |
| 1,000 ft. ash poles | 23 |
| One horn socket with clevis | 7 |
| One 2-legged socket with dog | 14 |
| One 3½-in. drill sinker, 30 feet long | 55 |
| One 3-in. do do | 42 |
| One 2½ in. do do | 35 |
| One pair 1¼-in. jars | 26 |
| One pair 1⅛-in. jars | 23 |
| One pair 1-in. jars, for fishing | 15 |
| Two Dutchman's subs | 18 |
| Three 6-in. drill bits | 54 |
| Three 4¾ in. do | 42 |
| One 12-in. mud bit | 15 |
| One 8-in. reamer | 16 |
| One 6-in. do | 14 |
| One 5-in. do | 13 |
| Two tool wrenches | 10 |
| Two pole wrenches | 4 |
| Twenty pairs pole joints and centre straps | 70 |
| One drill swivel and drill chain | 14 |
| One draw swivel | 8 |
| One cast-iron spring pole jacket | 6 |
| One slipper-out with cast wheel | 15 |
| One pole holder | 2 |
| One weight and two clevises for rope | 4 |
| One 4-in. sand pump, 36 feet long | 27 |

| | |
|---|---|
| One sand pump hanger and chain | $ 4 |
| Two chain rings and hooks for tools | 3 |
| One lever and two chains for wrenches | 3 |
| One ⅝-in. chain ring and hook for casing | 8 |
| One stirrup bolt, king bolt and plate | 4 |
| Two 1¼-in. clamp bolts | 4 |
| One chain and swivel for spool | 3 |
| One 12-inch auger | 18 |
| One 8-in. mud pump | 14 |
| 100 feet boring stems and connections | 45 |
| Total | $ 1,715 |

## APPENDIX C.

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The following list of works referring to the hydrocarbons in Canada is taken from the Report on Petroleum by S. F. Peckham, vol. X., 10th Census, U. S. For those interested in the study of hydrocarbons there is no better list. Some additions have been made to the list by the writer, of works referring to boring operations, or otherwise intimately connected with the subject.

*Abbreviations.*

Abbreviations

A.J.S.—American Journal of Science and Arts (Silliman's Journal).
A.J.G.L.—American Journal of Gas-lighting.
An. M.—Annales des Mines.
A.S.J.—Art Society Journal.
B.B.S.N.S.—Bulletin of the Buffalo Society of Natural Sciences.
B.S.G.F.—Bulletin de la Société Géologique de France.
C.J.—Canadian Journal.
C.R.—Comptes-Rendus des séances de l'Académie Française.
C.N.—London Chemical News.
C. Nat.—Canadian Naturalist.
S. Report.—Report of the Geological Survey of Canada.
F.I.—Journal of the Franklyn Institute.
S.A.—Journal of the Society of Arts.
R.G.S.—Journal of the Royal Geographical Society.
C.I.—Journal of the Society of Chemical Industry.
A.A.S.—Proceedings of the American Association for the Advancement of Science.
P.S.—Proceedings of the American Philosophical Society, Philadelphia.
S.N.H.—Proceedings of the Boston Society of Natural History.
.—Proceedings of the Canadian Institute.
.—Pharmaceutical Journal, London.
M.E.—Transactions American Institute of Mining Engineers.
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| 1890 | . . . . . . . . |

# MAP OF SOUTH-WESTERN ONTARIO.

## VOL. V, PART Q.

# PLATE V, VOL. V, PART Q.

**Section: Port Colborne to Kincardine.**

# PLATE IV, VOL. V, PART Q.

**Section: Whitby, Ont., to Courtright.**

GEOLOGICAL SURVEY OF CANADA.
ALFRED R. C. SELWYN, C.M.G., LL.D., F.R.S., DIRECTOR.

# CHEMICAL CONTRIBUTIONS

TO THE

# GEOLOGY OF CANADA

FROM THE

LABORATORY OF THE SURVEY

BY

G. CHRISTIAN HOFFMANN, F. Inst. Chem., F.R.S.C.,
Chemist and Mineralogist to the Survey.

ASSISTANTS

F. G. WAIT, M.A., F.C.S.,
R. A. A. JOHNSTON.

OTTAWA
PRINTED BY S. E. DAWSON, PRINTER TO THE QUEEN'S MOST
EXCELLENT MAJESTY
1892

To ALFRED R. C. SELWYN, C.M.G., LL.D., F.R.S.,
*Deputy Head and Director of the Geological Survey of Canada.*

SIR,—I have the honour of herewith laying before you my report upon the work carried out in the Laboratory of this Survey during the year 1890, and in so doing desire to point out that owing to exceptional ircumstances it has, on this occasion, been found impracticable either o incorporate the whole of the work conducted in that year or to avoid the introduction of certain other of more recent date. The principal work held over, and which related to building stones, was well advanced, but not sufficiently so for publication, when it was ound necessary to temporarily lay the same aside in order to carry out the analysis of a series of nickel and cobalt ores, a work more urgently called for by reason of the interest and economic importance now attaching to these latter. The analyses of a few of the most important of these although made out of the proscribed limit of time have nevertheless been included in this report in order to make the work in this connection as complete as possible and avoid delay in their publication. Again, although the examination of the series of salt waters was all but finished at the close of the year in question, a little of the work in connection with the same extended into the following year and this could not have been excluded from the present report without leaving the matter in an incomplete form or deferring the publication of the work already accomplished in connection with it.

Of the work herein recorded—the analyses of the brines from Manitoba and the district of Saskatchewan were, together with some other analyses, conducted by Mr. F. G. Wait; whilst the analysis of the series of nickel ores, as likewise the gold and silver assays, and many other analyses and examinations the results of which are herein formulated, were conducted by Mr. R. A. A. Johnston. The analyses made by these gentlemen have, in all instances, been duly credited to them—the work not otherwise particularized having been carried out by myself.

I have the honour to be,
Sir,
Your obedient servant,
G. CHRISTIAN HOFFMANN.

OTTAWA, 30th November, 1891.

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# LABORATORY OF THE SURVEY.

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## MISCELLANEOUS MINERALS.

**Miscellaneous minerals.**

### 1. Ilvaite.

**Ilvaite from near the head of Barclay Sound, Vancouver Island, British Columbia.**

Several specimens of what proved to be this rare mineral were received for identification from a gentleman, who described it as occurring in large irregular masses in a vein about twenty feet wide, near the head of Barclay Sound, Vancouver Island, British Columbia.

Portions of the material were fairly free from foreign admixture, containing only small quantities of white, translucent, cleavable calcite; this, however, was in some fragments supplemented by inclusions of altered tremolite, and in others by a brownish-yellow andradite. It had a more or less closely compacted crystalline structure. The lateral faces of crystals were not infrequently striated longitudinally, and sometimes exhibited a slight iridescent tarnish. Colour, iron-black; streak, greenish-black; lustre, sub-metallic; brittle; fracture, uneven. Before the blow-pipe fuses quietly at about 2·5 to a black magnetic globule. Hardness, 5·5; specific gravity, 3·859. Readily decomposed by hydrochloric acid, forming a yellow jelly.

An analysis conducted upon very carefully selected and prepared material, dried at 100° C., afforded me the following results:

| | |
|---|---|
| Silica | 29·81 |
| Alumina | 0·16 |
| Ferric oxide | 18·89 |
| Ferrous oxide | 32·50 |
| Manganous oxide | 2·22 |
| Lime | 13·82 |
| Magnesia | 0·30 |
| Water | 1·62 |
| | 99·32 |

**Miscellaneous minerals-*Con.***

## 2. NATIVE IRON.[1]

**Native iron from St. Joseph Island, Lake Huron, Ontario.**

In the course of examining some surface specimens of quartzite[2] from the north shore—fifth concession, back of Campement d'Ours—of St. Joseph Island, Lake Huron, Ontario, it was observed that certain faces, apparently fissure surfaces, of the same were coated with a thin deposit of dark reddish-brown limonite through which was disseminated numerous metallic looking spherules, thereby imparting to it an oolitic structure. In the specimen which best showed its mode of occurrence, this deposit formed a layer on one face of from one to one and a-half millimetre in thickness, and this, judging from the appearance of the exposed surface of the same, which showed indications of having been a contact surface, may perhaps be fairly assumed to represent the diameter of the original fissure. Running parallel to and in direct communication with the latter was a gouge-shaped groove measuring where it opened into the fissure, its widest part, five millimetres across, and having a varying depth of from five to six millimetres. This groove, retaining these dimensions, extended right across the face of the specimen, which face, in this direction, measured four centimetres. There was nothing to indicate what the probable length of this groove may have been, as it occurred in the rock, *in situ*, or whether it occupied a vertical, horizontal, or intermediate position, although conjecture might perhaps, in this particular instance, favour the former view. It was closely packed with material of precisely the same character as that contained in the fissure, the material of the one forming an uninterrupted connection with and, as it were, extension of, that of the other, so that we may indifferently regard the material in the fissure as an overflow from the groove, or that in the latter, more especially if this merely represented an elongated cavity, as a filling in from the former.

No metallic grains or matter likely to have resulted from the alteration of the same, or mineral from which the iron could possibly have been derived, was observable in any other part of the specimens examined.

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[1] The material in question formed the subject of a paper by me, entitled "On a peculiar form of Metallic Iron found in Huronian quartzite, on the north shore of St. Joseph Island, Lake Huron, Ontario," which appeared in the Transactions of the Royal Society of Canada, vol. VIII. (1890), sec. iii. p. 39. The coloured plate illustrating that paper is here unavoidably omitted.

[2] A greyish, in parts greenish and brownish coloured quartzite, with here and there an inclusion of white vitreous quartz, and red and blackish or brownish-black jasper.

The material which, as already remarked, had an oolitic structure, was dense in texture and firmly adherent to the face of the quartz. It was found to be made up of:

Miscellaneous minerals—*Con.*

| | |
|---|---|
| Metallic grains | 58·85 |
| Limonite | 39·73 |
| Siliceous matter | 1·42 |
| | 100·00 |

Native iron from St. Joseph Island, Lake Huron, Ontario—*Con.*

The siliceous matter consisted of angular particles of quartz which had evidently been chipped off with, and remained attached to, the material when removing it from the rock.

The metallic grains varied greatly in size, the largest not exceeding thirty-seven hundredths of a millimetre in diameter, whilst many, perhaps the greater number, were of far smaller dimensions, and others were of microscopic minuteness. Although diverse in form yet all were rounded and, for the most part, more or less spherical in shape. They were strongly attracted by the magnet and after separation by its aid from the associated non-metallic matter, aggregated themselves into loose bunchy masses or formed trains. Brittle—in the process of pulverization emitted a faint yet distinct phosphoretted odour. Colour of freshly fractured surface of metal, steel-grey. When immersed in a solution of cupric sulphate the grains became immediately coated with a film of metallic copper. They were readily attacked by hydrochloric acid with evolution of hydrogen possessing a marked odour of phosphine, the latter, however, gradually passed off as digestion proceeded, when a peculiar fetid smell similar to that which characterizes hydrogen evolved from wrought iron or impure zinc, was observable. Hydrochloric acid did not effect complete solution—the undissolved material still presenting a metallic aspect; a further treatment with nitric acid, however, removed the remaining metallic matter, leaving a granular, nucleiform, non-metallic, insoluble residue.

The metallic spherules were found to have a specific gravity, at 15·5°C., of 6·8612, and a composition, as follows:

| | |
|---|---|
| Iron | 88·00 |
| Manganese | 0·51 |
| Nickel | 0·10 |
| Cobalt | 0·21 |
| Copper | 0·09 |
| Sulphur | 0·12 |
| Phosphorus | 0·96 |
| Carbon | |
| Organic matter | undet. |
| Insoluble, non-metallic, residue | 9·76 |
| | 99·75 |

**Miscellaneous minerals**-*Con.*

**Native iron from St. Joseph Island, Lake Huron, Ontario**-*Con.*

The insoluble residue consisted of spherical, ovoid, &c., shaped grains which were more or less coated with a yellowish-brown, apparently humus-like, substance. When broken, these spherules were seen to have a concentric structure, apparently of a concretionary character. On ignition the organic matter readily burnt off, leaving them snow-white. The ignited spherules were found to be exceedingly hygroscopic, so much so, that in the short space of time occupied in their transference from one container to another, they absorbed not less than 0·775 per cent of water.

An analysis of this residue gave the following results:

| | |
|---|---|
| Silica | 9·17 |
| Alumina | 0·11 |
| Ferric oxide | 0·10 |
| Lime | 0·06 |
| Magnesia | 0·03 |
| Loss? [3] | 0·29 |
| | 9·76 |

Hence, the centesimal composition of the metallic portion of the spherules, would be:

| | |
|---|---|
| Iron | 97·79 |
| Manganese | 0·57 |
| Nickel | 0·11 |
| Cobalt | 0·23 |
| Copper | 0·10 |
| Sulphur | 0·13 |
| Phosphorus | 1·07 |
| Carbon | ? |
| | 100·00 |

and that of the insoluble, non-metallic, residue:

| | |
|---|---|
| Silica | 93·95 |
| Alumina | 1·13 |
| Ferric oxide | 1·02 |
| Lime | 0·62 |
| Magnesia | 0·31 |
| Loss? [3] | 2·97 |
| | 100·00 |

The limonite did not contain any, so to say, denuded nuclei, so that supposing it to have resulted from the weathering of the metallic spherules, the change had, in no instance, proceeded so far as to effect

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[3] The analysis was conducted upon a very small amount of material—the silica may, not improbably, be a little too low.

Miscellaneous minerals—*Con.*

the removal of the whole of the metallic covering. Some of the nuclei were of microscopic minuteness, hence it may be inferred that even the smallest of the metallic spherules contained a siliceous nucleus. The limonite gave no reaction for chlorine.

Native iron from St. Joseph Island, Lake Huron, Ontario—*Con.*

From what has preceded it will be seen that the metallic looking spherules which were disseminated through the limonite, consisted of nuclei of silica coated with a humus-like substance which in turn was overlain by a metallic layer—the latter containing all the elements most frequently met with in meteoric iron. The amount of phosphorus is relatively large, that of the nickel, however, very small, consequently if it be regarded as present in the form of any of the varieties of nickel-iron or schreibersite, it would represent but comparatively trifling amounts of either of these bodies.

Owing to the fact that all meteoric iron contains nickel, the presence of that element in a native iron has generally been regarded as evidence of its extra-terrestrial origin and for this reason the irons of Chotzen and Petropaulwosk although sometimes mentioned in connection with those of accepted telluric origin [4] are, in consideration of their having been shown to be nickeliferous, referred to by some authorities as most probably of meteoric origin. It will be remembered, however, that the native iron of Ovifak, Disco Bay, Greenland, which was at first regarded by the discoverer, Nordenskiöld, and others as meteoric iron, also contains a certain amount of nickel, yet the observations of Steenstrup, Törnebohm and Smith, make it very certain that the iron is not meteoric but of terrestial origin, in which case the presence of nickel in an iron would not have the same significance as it was formerly supposed to have.

Assuming, therefore, that the trifling amount of nickel present in this iron would not necessarily imply a cosmic origin, the relatively large amount of phosphorus accompanying the nickel, the presence of organic matter [5] and the fact of the spherules containing nuclei, apparently of a concretionary character, would suggest the possibility of this iron having a terrestrial source, upon the assumption that it has result-

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[4] Such as the iron found by Andrews in basaltic rocks from the Giants Causeway, and that found by Mossier in lava from Graveneire in Auvergne.

[5] The presence of organic matter of the nature (humus-like) of that here referred to would not appear to be inconsistent with an extra-terrestrial origin. The meteorite of Alais contained a carbonaceous matter which Berzelius considered might not improbably be humus. Wöhler found the carbonaceous matter of the Kold-Bokeveldt and Kaba meteorites to consist of a mixture of amorphous carbon and bituminous matters, described as not unlike Scheererite or Ozocerite. Cloez again, found the carbonaceous matter of the Orgueil meteorite to resemble, both in appearance and composition, certain humus substances.

Miscellaneous minerals-*Con.*

ed from the reduction of an iron-salt by organic matter, in which case it would have a community of origin with the sideroferrite[6] of Bahr.

### 3. HARMOTOME.

Harmotome from O'Connor, district of Thunder Bay, Ontario.

From the Beaver mine, township of O'Connor, district of Thunder Bay, province of Ontario; collected by Dr. A. C. Lawson.

It occurs, in small crystals implanted on prisms of calcite resting on a layer of crystalline quartz, coating the surface of a dark grey shale, traversed by seams of similar quartz and purple fluorite. Numerous isolated crystals of pyrite, or small aggregations of the same, occur disseminated through the shale as well as attached to the layer of quartz upon which the calcite crystals rest.

Specific gravity (employing 0·0848 gram of the mineral), at 15·5° C., 2·39. An analysis conducted upon 0·0798 gram material (employing the ammonium chromate method for separation of baryta from lime) afforded me the following results:

| | |
|---|---|
| Silica | 46·36 |
| Alumina | 17·16 |
| Baryta | 21·18 |
| Lime | 2·25 |
| Potassa | ? |
| Soda | ? |
| Water | 14·54 |
| | 101·49 |

### 4. COMMON OPAL.

Common opal from Savona Mountain, British Columbia.

Very characteristic specimens of this mineral were found by Dr. G. M. Dawson (Survey) in the Tertiary basaltic breccia or agglomerate rocks of Savona Mountain, south of Savona station on the line of the Canadian Pacific Railway, British Columbia. Their examination afforded me the following results:

Colour, white, pale greenish-white, and apple-green. Translucent. Lustre, subvitreous. Fracture, conchoidal. Does not adhere to the tongue. On ignition turns porcelain-white and becomes opaque. Specific gravity, 2·012—of the same material, after ignition, 2·083. It is readily attacked, and almost completely soluble, in a boiling solution of caustic potash; the undried material leaving, when submitted to

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[6] A native iron found by Bahr, in the form of grains, thin laminae and powder, in a fragment of mineralized wood—resembling bog-iron ore in appearance—from a floating island in the Ranälnger Lake in Småland, Sweden.

**Miscellaneous minerals-*Con.***

the action of this reagent, an insoluble residue amounting to only 1·92 per cent. An analysis of this gave silica 0·76, alumina 0·23, ferric oxide 0·26, lime 0·35, magnesia 0·23, alkalies ? 0·09 = 1·92.

**Common opal from Savona Mountain, British Columbia-*Con.***

The material rapidly gains or loses water, according to the hygrometric condition of the atmosphere, as is exemplified by the following experiments :

Portions of the finely pulverized mineral were placed in a perfectly dry atmosphere, that is to say, over strong sulphuric acid under a bell jar, and left, weighing at intervals, under these conditions until the last weighing indicated no further diminution in weight. It was found that—

| | | | | | I. | | II. | |
|---|---|---|---|---|---|---|---|---|
| After the first exposure of | 24 hours, | the loss amounted to | | | 2·477 | p.c. | 2·550 | p.c. |
| " second | " | 24 | " | " | 0·313 | " | 0·356 | " |
| " third | " | 24 | " | " | 0·261 | " | 0·207 | " |
| " fourth | " | 24 | " | " | 0·130 | " | 0·119 | " |
| " fifth | " | 24 | " | " | 0·078 | " | 0·015 | " |
| " sixth | " | 24 | " | " | nil. | | nil. | |
| Total loss.................................. | | | | | 3·259 | | 3·247 | |

or a mean loss of 3·25 per cent for the total period of 120 hours. The percentage of water in the original mineral, as determined by ignition over a Bunsen blast-lamp, amounted to—

| I. | II. | Mean. |
|---|---|---|
| 7·040 | 6·968 | 7·00 |

deducting from this the loss incurred by the mineral when exposed to a dry atmosphere, it will be seen that it persistently retains, at the ordinary temperature, 3·75 per cent of this water under the conditions stated.

The above portions of material, dried in the manner indicated, were now placed in an atmosphere saturated with moisture. This was accomplished by substituting for the glass dish containing sulphuric acid, in above experiment, one containing a shallow stratum of water, over which was heaped shreds of filtering paper, the bell jar inclosing the experiments being in turn covered by one of larger dimensions, to prevent deposition of dew. The exposure was continued, weighing at intervals, until the last weighing indicated no further increase in weight. It was found that—

**Miscellaneous minerals**-*Con.*

**Common opal from Savona Mountain, British Columbia**-*Con.*

| | | | | | | I. | | II. | |
|---|---|---|---|---|---|---|---|---|---|
| After a | first | exposure of | 48 hours, | the gain | amounted to | 6·206 | p.c. | 6·272 | p.c |
| " | second | " | 72 | " | " | 0·235 | " | 0·178 | " |
| " | third | " | 72 | " | " | 0·182 | " | 0·119 | " |
| " | fourth | " | 72 | " | " | 0·052 | " | 0·089 | " |
| " | fifth | " | 72 | " | " | 0·052 | " | 0·059 | " |
| " | sixth | " | 72 | " | " | 0·026 | " | 0·029 | " |
| " | seventh | " | 72 | " | " | nil. | | nil. | |
| | | | Total gain | ...................... | | 6·753 | | 6·746 | |

or a mean gain, by absorption of water, of 6·75 per cent for the total period of 408 hours exposure. Hence, not only had the mineral regained the whole of the water previously lost by exposure to a dry atmosphere, but in addition absorbed 3·50 per cent more than it originally contained.

Some further experiments, bearing upon the absorption of water by the original mineral, were made in which the latter was employed in the form of fragments. These were of fairly large dimensions, five to eight millimetres diameter, and apparently free from fissures. One portion of this material was placed in an atmosphere saturated with moisture and, as in previous instances, left there, weighing at intervals, until no further increase in weight was perceptible. It was observed that in the course of—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| The | first | exposure of | 72 hours, | the mineral absorbed | 3·181 | p.c. | water. |
| " | second | " | 72 | " | 0·030 | | " |
| " | third | " | 72 | " | 0·040 | | " |
| " | fourth | " | 72 | " | 0·030 | | " |
| " | fifth | " | 72 | " | nil. | | |
| | | | Total gain | .................. | 3·281 | | |

This material was next immersed in water for 48 hours, then withdrawn, the superfluous moisture removed by a soft absorbent cloth, and reweighed. The weight coincided with that previous to immersion, consequently no further absorption had taken place. The percentage of water absorbed by the mineral, in addition to that which it originally contained, amounted therefore to 3·28 per cent.

The remaining portion of the material was immersed in water for about forty hours, after which the water was poured off, the superfluous moisture removed, and the mineral weighed. The weight indicated an increase by absorption of water of 3·29 per cent. This agrees very closely with the result obtained in the last experiment, but is, as perhaps might have been anticipated, somewhat lower than in the experiments in which the material was employed in a finely powdered condition.

Miscellaneous minerals-*Con.*

A portion of the material, in the form of fragments, was ignited over a Bunsen blast-lamp, and placed in an atmosphere saturated with moisture. The increase in weight, even after an exposure of 264 hours, was so slight that it was deemed unworthy of recording.

Common opal from Savona Mountain, British Columbia-*Con.*

Briefly stated—the mineral contained, at the time of its examination, 7·00 per cent of water ; of this it lost 3·25 per cent, persistently retaining the balance of 3·75 per cent when exposed to a perfectly dry atmosphere at the ordinary temperature. On exposure to a moist atmosphere, of a similar temperature, it rapidly regained the water thus lost, and, in addition, absorbed 3·50 per cent more than it originally contained. The mineral after strong ignition, when placed under similar conditions, experienced such a slight increase in weight that it may be said to be non-absorbent.

## 5. DANAITE.

Danaite from Graham, district of Algoma, Ontario-*Con.*

This mineral, not previously identified as occurring in Canada, was met with, in diorite, in the course of developing a deposit of nickeliferous pyrrhotite on the north half of lot six, in the third range of the township of Graham, district of Algoma, Ontario. Examined for Mr. D. L. McLean.

The results of the examination are as follows :—

Massive, structure, more or less crystalline granular. Colour, steel-grey. Intermixed with it were small quantities of white translucent quartz, some pyrrhotite, a little galenite, and a trifling amount of chalcopyrite, and attached to one of the faces of the specimen was a layer of greyish-green serpentine. Specific gravity (after correction for a little included quartz), at 15·5° C., 5·988.

An analysis, by Mr. R. A. A. Johnston, of carefully selected material, showed the same to have the composition given under I. If the gangue (silica) be deducted and the remainder of the analysis recalculated for one hundred parts, we obtain the figures given under II.

| | I. | II. |
|---|---|---|
| Arsenic | 40·16 | 42·22 |
| Sulphur | 17·92 | 18·84 |
| Iron | 31·69 | 33·32 |
| Cobalt | 3·89 | 4·09 |
| Nickel | 0·88 | 0·93 |
| Antimony | 0·57 | 0·60 |
| Gold | trace. | trace. |
| Gangue (quartz) | 4·77 | ..... |
| | 99·88 | 100·00 |

### 6. TRIPOLITE OR INFUSORIAL EARTH.

Miscellaneous minerals - *Con.*

From the head of Loon Lake, Interior plateau, British Columbia. Geological position, Tertiary. Received, for identification, from Mr. F. W. Foster—who stated that it was said to constitute an extensive deposit at the aforementioned locality.

Tripolite from the head of Loon Lake, British Columbia.

It is very fine-grained, closely compacted and tough, with a coarse, dull, earthy fracture : is meagre and rough to the feel : adheres strongly to the tongue ; colour, light reddish.

Some slides of this material were prepared by Mr. T. C. Weston, and these showed it to be almost entirely made up of frustules of Diatomaceæ—some siliceous spicules of fresh water sponges being also present.

Professor A. H. MacKay, who has kindly undertaken a critical examination of this earth, informs me that although the work is not yet completed the conclusions he has arrived at in regard to it, thus far, show that of the Diatomaceæ, *Melosira granulata*, Ehr., constitutes the most abundant species. *Melosira crenulata, Var.* (?), *Pinnularia major*, Rab., *Pinnularia viridis*, Rab., *Pinnularia divergens*, W. Sm., *Navicula legumen*, Ehr., *Navicula mesolepta, var. nodosa*, Ehr., *Cymbella Ehrenbergii*, Kütz., *Asterionella formosa*, Hass., and *Fragillaria mutabilis*, Gun. (?), being also represented—and that among the sponge spicules were, *Spongilla fragilis*, Leidy and varieties, *Spongilla lacustris*, Linn. (?), and *Meyenia fluviatilis*, Carter.

This material has been used by the Indians in the vicinity of Cache Creek for making tobacco-pipes—a not inappropriate application in view of the facility with which it may be carved, its lightness and absorbent power. The opening up of the locality may lead to its employment for many purposes for which it can now be scarcely regarded as available by reason of the present difficulties and cost attendant upon its transport.

The occurrence of a diatomaceous earth, also of lacustrine origin, in the tertiary beds on Blackwater River, just above the bridge, is referred to by Dr. G. M. Dawson in his " Report on explorations in British Columbia," Rep. Geol. Surv. Can., 1875-76, p. 256, in the following words :—" The rocks are light coloured, chiefly pale greenish and greyish-white, and generally quite fine grained, constituting fireclays, which are sometimes massive but often thin bedded. Soft sandstones, and occasional beds with small pebbles, also occur. Some layers are highly diatomaceous, a species of *Melosira*, like *M. varians*, being most abundantly represented."

### 7. SCHEELITE.

Miscellaneous minerals—*Con.*

This mineral, a specimen of which was found and recognized by Mr. W. F. Ferrier (Survey), amongst a series of rock specimens collected by Mr. A. Webster in 1881, occurs on lot one of the seventh range of the township of Marlow, Beauce county, province of Quebec.

Scheelite from Marlow, Beauce county, province of Quebec.

In this specimen the scheelite occurred in crystals of a pale wine-yellow colour, together with some specular iron, pyrrhotite and pyrite, in a white sub-translucent quartz. Mr. R. A. A. Johnston found it to have a specific gravity, at 15·5°C., of 6·059, and—agreeably with the results of his analysis—the following composition :

| | |
|---|---|
| Tungstic acid | 79·90 |
| Lime | 19·37 |
| Ferric oxide | 0·70 |
| Silica | 0·29 |
| | 100·26 |

The mineral wolframite, a tungstate of iron and manganese, had already been met with by Professor Chapman, in a large boulder of gneiss, on the north shore of Chief's Island, in Lake Couchiching, province of Ontario.

### 8. CHROMIFEROUS MUSCOVITE.

Chromiferous muscovite from Matawatchan, Renfrew county, Ontario.

A very handsome, scaly, massive, bright emerald green muscovite, with some intermixed scales of a dark brown mica, a little quartz and a few grains of pyrite, occurs in the township of Matawatchan, Renfrew county, Ontario.

Mr. F. G. Wait found it to have a specific gravity at 15·5°C., of 2·93, and—agreeably with the results of his analysis—the following composition :

| | |
|---|---|
| Silica | 43·72 |
| Alumina | 35·51 |
| Ferric oxide | 2·94 |
| Chromic oxide | 1·26 |
| Manganous oxide | 0·26 |
| Lime | 4·46 |
| Magnesia | 1.36 |
| Potassa | 8·88 |
| Soda | 0·39 |
| Water (direct estimation) | 3·68 |
| | 102·46 |

### 9. GERSDORFFITE.

Miscellaneous minerals-*Con.*

Gersdorffite from Denison, district of Algoma, Ontario.

Has been met with at the O'Connor claim on lot twelve of the third range of the township of Denison, district of Algoma, Ontario, where it occurs with niccolite, chalcopyrite and pyrrhotite, in a gangue consisting of an association of a light to dark green, fine grained, diabase with small quantities of a dark green chloritic schist, a little greyish-white to white translucent quartz and a trifling amount of calcite.

Structure, for the most part lamellar, but occasionally granular; a few minute, fairly well developed crystals exhibiting the forms of the octahedron and cubo-octahedron, with the faces of the octahedron predominating, were also observed. Colour, steel-grey—here and there tarnished blackish. Specific gravity (after correction for a little included quartz), at 15·5°C., 6·231.

The material upon which the analysis was conducted, although selected with all possible care and, so far as could be seen, apparently pure, nevertheless contained, it was subsequently found, a very appreciable amount of quartz. Its analysis afforded Mr. R. A. A. Johnston the results given under I. Deducting the gangue (silica), and recalculating the remaining constituents for one hundred parts we obtain the figures given under II.

| | I. | II. |
|---|---|---|
| Arsenic | 40·31 | 46·96 |
| Sulphur | 14·34 | 16·71 |
| Nickel | 22·59 | 26·32 |
| Iron | 6·78 | 7·90 |
| Cobalt | 1·73 | 2·01 |
| Copper | 0·09 | 0·10 |
| Gangue (quartz) | 13·55 | .... |
| | 99·39 | 100·00 |

This mineral had not previously been identified as occurring in Canada.

Natural waters.

## NATURAL WATERS.

Water from boring on Kanak Creek, near Port Haney, British Columbia.

1.—Water from a boring on Kanak Creek, near Port Haney, district of New Westminster, British Columbia. Examined for Mr. H. Abbott.

Dr. G. M. Dawson informs me that this water rises from nearly horizontal beds of tertiary strata, consisting of sandstones, clay-shales, and conglomerates, resting upon granitic rocks.

Natural waters—*Con.*

It was bitter and saline to the taste. Specific gravity, at 15·5° C., 1·039. An analysis by Mr. F. G. Wait showed it to contain—in 1000 parts by weight—

Water from boring on Kanak Creek, near Port Haney, British Columbia—*Con.*

| | |
|---|---|
| Potassium | 0·202 |
| Sodium | 2·554 |
| Calcium | 14·980 |
| Magnesium | 0·015 |
| Chlorine | 30·740 |
| | 48·491 |
| Chlorine required, in addition to that found to satisfy bases | 0·018 |
| | 48·509 |

The foregoing constituents may reasonably be assumed to be present in the water in the following state of combination:

| | |
|---|---|
| Chloride of potassium | 0·385 |
| " sodium | 6·496 |
| " calcium | 41·569 |
| " magnesium | 0·059 |
| | 48·509 |
| Total dissolved solid matter, by direct experiment | 48·723 |

It contained no trace of sulphates. Barium and strontium were not sought for. Lithium was sought for, and not detected. Iodine was found to be present in notable amount, but no evidence of the presence of bromine was obtained.

The above water is remarkable for the very large amount of chloride of calcium which it contains and the great preponderance of this over the other constituents, amounting, as it does, to rather more than eighty-five per cent of the solid contents. The only other water of which, so far as I am aware, there is any recorded analysis, that can be compared with it, is one from a well on Manitoulin Island (Lake Huron, province of Ontario), examined by Dr. T. Sterry Hunt, the results of whose analysis, as calculated for 1000 parts, are as follows:—

| | |
|---|---|
| Chloride of potassium | 0·792 |
| " sodium | 4·800 |
| " calcium | 12·420 |
| " magnesium | 3·650 |
| | 22·662 |

It contained no trace of sulphates, barium or strontium. It was not examined for iodine or bromine, but these, it is remarked, were probably present.

Natural waters—*Con.*

The foregoing two waters, whilst resembling each other, in that they contain the same constituents, yet differ considerably as regards amounts and relative proportions of the same.

Water from hot spring on Kootanie Lake, British Columbia.

2.—Water from hot spring on the west side of Kootanie Lake, eight miles north of the West Arm, British Columbia. Collected by Dr. G. M. Dawson (Survey).

There are several outflows—the principal orifice, that from which this sample was collected, was roughly estimated to discharge about sixty gallons per minute. The temperature of the water at the time of collection, June 25, 1889, was found to be 101·5°F.

The water, which was odourless and devoid of any marked taste, contained 1·123 parts of dissolved solid matter, dried at 15·5°C., in 1000. A qualitative analysis afforded Mr. R. A. A. Johnston the following results:—

| | |
|---|---|
| Soda | small quantity. |
| Lime | large quantity. |
| Magnesia | very small quantity. |
| Alumina | trace. |
| Ferrous oxide | trace. |
| Sulphuric acid | very small quantity. |
| Carbonic acid | large quantity. |
| Silica | very small quantity. |
| Chlorine | large quantity. |
| Organic matter | trace. |

No evidence was obtained of the presence of potassa.

Water from hot spring on Upper Arrow Lake, British Columbia.

3.—Water from hot spring on the east side of Upper Arrow Lake (twelve miles from its head, and one hundred and fifty yards from the lake), British Columbia. Collected by Dr. G. M. Dawson (Survey).

Temperature of the water at the time of collection, June 13, 1889, 123·5°F. It contained 0·777 parts of dissolved solid matter, dried at 180°C., in 1000 parts, by weight, of the water. Agreeably with the results of a qualitative analysis, conducted by Mr. R. A. A. Johnston, it contained:

| | |
|---|---|
| Soda | very small quantity. |
| Lime | small quantity. |
| Magnesia | very small quantity. |
| Alumina | trace. |
| Ferrous oxide | trace. |
| Sulphuric acid | fairly large quantity. |
| Carbonic acid | trace. |
| Silica | very small quantity. |
| Chlorine | trace. |
| Organic matter | small quantity. |

Natural waters-*Con*.

Potassa was sought for, and not detected. On boiling, the water which was previously colourless, assumed a pale brownish tint.

A deposit which forms round the mouth of this spring was found by Mr. Johnston to consist of, approximately, 78 per cent silica, and 15 per cent alumina, together with small quantities of lime and magnesia.

Water from a well near Calgary, district of Alberta, North-west Territory.

.—Water from a well six miles south of Calgary, district of Alberta, North-west Territory. Examined for Mr. J. Bannerman.

The water was colourless, odourless, and devoid of any marked taste. It contained 0·843 parts of dissolved solid matter, dried at 180°C., in 1000 parts, by weight, of the water. A qualitative analysis by Mr. R. A. A. Johnston, showed it to contain:

| | |
|---|---|
| Soda | large quantity. |
| Lime | large quantity. |
| Magnesia | small quantity. |
| Ferrous oxide | trace. |
| Sulphuric acid | large quantity. |
| Carbonic acid | large quantity. |
| Chlorine | small quantity. |
| Organic matter | small quantity. |

Potassa was absent. Boiling produced a precipitate which con-sted for the most part of carbonate of lime, with some carbonate of iagnesia.

Water from a spring in Kenyon, Glengarry county, Ontario.

.—Water from a spring on lot four, range four, of the township of Kenyon, Glengarry county, Ontario. Examined for Mr. A. McDowell.

The water was perfectly colourless, clear and bright; devoid of odour and any marked taste. It contained 0·300 parts of dissolved solid matter, dried at 180°C., in 1000 parts, by weight, of the water. Mr. R. A. A. Johnston made a qualitative analysis of this water, and found it to contain:

| | |
|---|---|
| Soda | small quantity. |
| Lime | small quantity. |
| Magnesia | very small quantity. |
| Ferrous oxide | trace. |
| Sulphuric acid | small quantity. |
| Phosphoric acid | trace. |
| Carbonic acid | small quantity. |
| Chlorine | small quantity. |
| Organic matter | very small quantity. |

Potassa was found to be absent.

**Natural waters-*Con.***

**Water from springs on shore of Lake St. John, Chicoutimi county, province of Quebec.**

6.—This water, which rises from the Trenton formation, is found issuing along the shore of Lake St. John, at Chambord—first range of the township of Metabetchouan, Chicoutimi county, province of Quebec—for a distance of about eight hundred yards, and about five feet below high water mark. Examined for Mr. J. G. Scott.

When received it contained a trifling amount of suspended matter. This was removed by filtration. The filtered water, which had a very bitter saline taste, was colourless and odourless. It was found to have a specific gravity, at 15·5°C., of 1·0345, and to contain 45·719 parts of dissolved solid matter (anhydrous) in 1000 parts, by weight, of the water. A qualitative analysis, conducted by Mr. F. G. Wait, showed it to contain:

| | |
|---|---|
| Soda | large quantity. |
| Lime | very large quantity. |
| Magnesia | small quantity. |
| Sulphuric acid | small quantity. |
| Chlorine | very large quantity. |
| Bromine | distinct trace. |
| Iodine | distinct trace. |

This water would appear to have much the same general composition as those of Ancaster and Hallowell. These contain chloride of sodium with large proportions of chlorides of calcium and magnesium, some sulphates, as likewise bromides and iodides.

*The following series of brines represent all the principal salt springs on Swan and Winnipegosis Lakes, province of Manitoba, and on the Red Deer River, district of Saskatchewan, North-west Territory. They were collected by Mr. J. B. Tyrrell, and are referred to by him in his report on the Geology of North-western Manitoba—this volume, Part E. The analyses were all conducted by Mr. F. G. Wait.*

**Water from spring near shore of Dawson Bay, east of mouth of Steep Rock River, Lake Winnipegosis, Manitoba.**

7.—From spring on hillside, near the shore of Dawson Bay, two miles east of the mouth of Steep Rock River, Lake Winnipegosis. Collected August 8, 1889.

It had a specific gravity, at 15·5°C., of 1·041, and contained in 1000 parts, by weight, as follows:

| | |
|---|---|
| Potassium | 1·296 |
| Sodium | 20·054 |
| Calcium | 1·231 |
| Magnesium | 0·315 |
| Sulphuric acid ($SO_4$) | 3·025 |
| Chlorine | 32·732 |
| | 58·653 |
| Chlorine required, in addition to that found, to satisfy bases | 0·275 |
| | 58·928 |

Natural waters—*Con.*

Water from spring near shore of Dawson Bay, east of mouth of Steep Rock River, Lake Winnipegosis, Manitoba—*Con.*

Hypothetical combination:

| | |
|---|---|
| Chloride of potassium | 2·473 |
| " sodium | 51·005 |
| " magnesium | 1·176 |
| Sulphate of lime | 4·185 |
| " magnesia | 0·089 |
| | 58·928 |

Total dissolved solid matter, by direct experiment, dried at 180°C., 59·219.

It contained a trace of lithium. Barium, strontium, bromine and iodine, were not sought for.

Water from spring near shore of Dawson Bay, north of mouth of Steep Rock River, Lake Winnipegosis, Manitoba.

8.—From spring near the west shore of Dawson Bay, three-quarters of a mile north of the mouth of Steep Rock River, Lake Winnipegosis. Collected August 6, 1889.

Specific gravity, at 15·5°C., 1·039. It contained in 1000 parts, by weight:

| | |
|---|---|
| Potassium | 1·509 |
| Sodium | 18·393 |
| Calcium | 1·198 |
| Magnesium | 0·357 |
| Sulphuric acid ($SO_4$) | 2·889 |
| Chlorine | 30·647 |
| | 54·993 |
| Chlorine required, in addition to that found to satisfy bases | 0·156 |
| | 55·149 |

Hypothetical combination:

| | |
|---|---|
| Chloride of potassium | 2·879 |
| " sodium | 46·781 |
| " magnesium | 1·399 |
| Sulphate of lime | 4·073 |
| " magnesia | 0·017 |
| | 55·149 |

Total dissolved solid matter, by direct experiment, dried at 180°C., 54·579.

It contained a trace of lithium. Barium, strontium, bromine and iodine were not sought for.

Natural waters—*Con.*

Water from Salt Point, south-west shore of Dawson Bay, Lake Winnipegosis, Manitoba.

9.—From Salt Point, on the south-west shore of Dawson Bay, Lake Winnipegosis. Collected August 3, 1889.

Specific gravity, at 15·5°C., 1·044. It contained in 1000 parts, by weight:

| | |
|---|---|
| Potassium | 0·989 |
| Sodium | 20·899 |
| Calcium | 1·098 |
| Magnesium | 0·328 |
| Sulphuric acid ($SO_4$) | 3·154 |
| Chlorine | 33·939 |
| | 60·407 |
| Chlorine in excess of that required to satisfy bases | 0·199 |
| | 60·208 |

Hypothetical combination:

| | |
|---|---|
| Chloride of potassium | 1·887 |
| " sodium | 53·155 |
| " magnesium | 0·649 |
| Sulphate of lime | 3·733 |
| " magnesia | 0·784 |
| | 60·208 |

Total dissolved solid matter, by direct experiment, dried at 180°C., 61·06.

It contained a trace of lithium, also a trace of iodine, but n bromine, nor were barium and strontium detected.

Water from spring on west side of Dawson Bay, north of mouth of Bell River, Lake Winnipegosis, Manitoba.

10.—From spring on west side of Dawson Bay, three miles and a-ha north of the mouth of Bell River, and a mile back from the la shore, Lake Winnipegosis. Collected August 2, 1889.

Specific gravity, at 15·5°C., 1·041. It contained in 1000 pa by weight:

| | |
|---|---|
| Potassium | 1·044 |
| Sodium | 19·819 |
| Calcium | 1·251 |
| Magnesium | 0·328 |
| Sulphuric acid ($SO_4$) | 2·909 |
| Chlorine | 32·357 |
| | 57·708 |
| Chlorine required, in addition to that found, to satisfy bases | 0·220 |
| | 57·928 |

**Natural waters—*Con.***

**Water from spring on west side of Dawson Bay, north of mouth of Bell River, Lake Winnipegosis, Manitoba—*Con.***

ypothetical combination :

| | |
|---|---|
| Chloride of potassium | 1·992 |
| " sodium | 50·408 |
| " calcium | 0·108 |
| " magnesium | 1·299 |
| Sulphate of lime | 4·121 |
| | 57·928 |

Total dissolved solid matter, by direct experiment, dried at 180°C., 57·992.

It contained a very distinct trace of lithium and faint traces of rontium and iodine. Barium and bromine were absent.

**Water from brook on west side of Dawson Bay, Lake Winnipegosis, Manitoba.**

rom brook flowing into the west side of Dawson Bay, Lake 'innipegosis. Collected August 1, 1889.

Specific gravity, at 15·5°C., 1·063. It contained in 1000 parts, ' weight :

| | |
|---|---|
| Potassium | 0·607 |
| Sodium | 32·415 |
| Calcium | 1·681 |
| Magnesium | 0·478 |
| Sulphuric acid ($SO_4$) | 4·243 |
| Chlorine | 50·118 |
| | 89·542 |
| Chlorine required, in addition to that found, to satisfy bases | 0·248 |
| | 89·790 |

ypothetical combination :

| | |
|---|---|
| Chloride of potassium | 1·158 |
| " sodium | 80·970 |
| " magnesium | 1·686 |
| Sulphate of lime | 5·715 |
| " magnesia | 0·261 |
| | 89·790 |

Total dissolved solid matter, by direct experiment, dried at 180°C., 88·946.

It contained traces of lithium, but neither barium nor stronum. Bromine and iodine were not sought for.

Natural waters—*Con.*

Water from spring on shore on Pelican Bay, Lake Winnipegosis, Manitoba.

12.—From spring on the shore of Pelican Bay, just east of the mouth of Pelican Creek, Lake Winnipegosis. Collected July 21, 1889.

Specific gravity, at 15·5°C., 1·039. It contained in 1000 parts, by weight:

| | |
|---|---|
| Potassium | 1·296 |
| Sodium | 20·054 |
| Calcium | 1·247 |
| Magnesium | 0·313 |
| Sulphuric acid ($SO_4$) | 3·114 |
| Chlorine | 32·888 |
| | 58·912 |
| Chlorine required, in addition to that found, to satisfy bases | 0·077 |
| | 58·989 |

Hypothetical combination:

| | |
|---|---|
| Chloride of potassium | 2·473 |
| " sodium | 51·005 |
| " magnesium | 1·120 |
| Sulphate of lime | 4·240 |
| " magnesia | 0 151 |
| | 58·989 |

Total dissolved matter, by direct experiment, dried at 180°C., 59·080.

It contained a trace of lithium, faint traces of bromine and trace of iodine. Barium and strontium were absent.

Water from spring on Pine Creek, Lake Winnipegosis, Manitoba.

13.—From spring on the west side of the mouth of Pine Creek, ne its discharge into Lake Winnipegosis. Collected July 6, 1889.

Specific gravity, at 15·5°C., 1·022. It contained in 1000 pa by weight:

| | |
|---|---|
| Potassium | 1·100 |
| Sodium | 10·298 |
| Calcium | 0·924 |
| Magnesium | 0·282 |
| Sulphuric acid ($SO_4$) | 2·028 |
| Chlorine | 17·955 |
| | 32·587 |
| Chlorine in excess of that required to satisfy bases. | 0·088 |
| | 32·499 |

**Natural waters—*Con.***

**Water from spring on Pine Creek, Lake Winnipegosis, Manitoba—*Con.***

Hypothetical combination:

| | |
|---|---|
| Chloride of potassium | 2·099 |
| " sodium | 26·192 |
| " calcium | 0·219 |
| " magnesium | 1·116 |
| Sulphate of lime | 2·873 |
| | 32·499 |

Total dissolved solid matter, by direct experiment, dried at 180°C., 32·633.

It contained a trace of lithium, but neither barium, strontium, bromine nor iodine.

**Water from Monkman's salt spring on west shore on Lake Winnipegosis, Manitoba.**

-From Monkman's salt spring on the west shore of Lake Winnipegosis. Collected July 1, 1889.

Specific gravity, at 15·5°C., 1·016. It contained in 1000 parts, by weight:

| | |
|---|---|
| Potassium | 0·359 |
| Sodium | 7·447 |
| Calcium | 0·847 |
| Magnesium | 0·239 |
| Sulphuric acid ($SO_4$) | 2·156 |
| Chlorine | 12·326 |
| | 23·374 |
| Chlorine required, in addition to that found, to satisfy bases | 0·109 |
| | 23·483 |

Hypothetical combination:

| | |
|---|---|
| Chloride of potassium | 0·685 |
| " sodium | 18·941 |
| " magnesium | 0·823 |
| Sulphate of lime | 2·880 |
| " magnesia | 0·154 |
| | 23·483 |

Total dissolved solid matter, by direct experiment, dried at 180°C., 23·304.

It contained a very distinct trace of lithium, as likewise of iodine. Barium, strontium, and bromine were also sought for and found to be absent.

Natural waters-*Con.*

Water from well on west shore of Lake Winnipegosis, Manitoba.

15.—From well at same locality as the last. Collected July 1, 1889. Specific gravity, at 15·5°C., 1·035. It contained in 1000 parts, by weight:

| | |
|---|---|
| Potassium | 0·167 |
| Sodium | 16·820 |
| Calcium | 1·245 |
| Magnesium | 0·496 |
| Sulphuric acid ($SO_4$) | 2·462 |
| Chlorine | 27·739 |
| | 48·929 |
| Chlorine required, in addition to that found, to satisfy bases | 0·229 |
| | 49·158 |

Hypothetical combination:

| | |
|---|---|
| Chloride of potassium | 0·319 |
| " sodium | 42·780 |
| " calcium | 0·608 |
| " magnesium | 1·963 |
| Sulphate of lime | 3·488 |
| | 49·158 |

Total dissolved solid matter, by direct experiment, dried at 180°C., 49·356.

It contained a trace of lithium and strontium, but no barium bromine or iodine.

Water from spring on west shore of Swan Lake, Manitoba.

16.—From spring half a mile back from the west shore of Swan Lak between it and the lower portion of Swan River. Collect August 31, 1889.

Specific gravity, at 15·5°C., 1·035. It contained in 1000 par by weight:

| | |
|---|---|
| Potassium | 1·004 |
| Sodium | 17·546 |
| Calcium | 1·196 |
| Magnesium | 0·272 |
| Sulphuric acid ($SO_4$) | 2·747 |
| Chlorine | 28·904 |
| | 51·669 |
| Chlorine in excess of that required to satisfy bases | 0·015 |
| | 51·654 |

Natural waters—*Con.*

Water from spring on west shore of Swan Lake, Manitoba—*Con.*

Hypothetical combination :

| | |
|---|---|
| Chloride of potassium | 1·916 |
| " sodium | 44·626 |
| " calcium | 0·144 |
| " magnesium | 1·077 |
| Sulphate of lime | 3·891 |
| | 51·654 |

Total dissolved solid matter, by direct experiment, dried at 180°C., 51·559.

It contained a trace of lithium, but no barium or strontium. Bromine and iodine were not sought for.

Water from lower salt spring on north side of Red Deer River, district of Saskatchewan, North-west Territory.

.—From lower salt spring on the north side of Red Deer River, a mile and three-quarters from its entry into Lake Winnipegosis. Collected August 13, 1889.

Specific gravity at 15·5°C., 1·031. It contained in 1000 parts by weight :—

| | |
|---|---|
| Potassium | 0·832 |
| Sodium | 15·124 |
| Calcium | 1·094 |
| Magnesium | 0·354 |
| Sulphuric acid ($SO_4$) | 2·285 |
| Chlorine | 25·494 |
| | 45·183 |
| Chlorine in excess of that required to satisfy bases. | 0·098 |
| | 45·085 |

Hypothetical combination :

| | |
|---|---|
| Chloride of potassium | 1·587 |
| " sodium | 38·466 |
| " calcium | 0·394 |
| " magnesium | 1·401 |
| Sulphate of line | 3·237 |
| | 45·085 |

Total dissolved solid matter, by direct experiment, dried at 180°C., 45·027.

It contained a trace of lithium, and faint traces of iodine, but no bromine. Barium and strontium were also absent.

18.—From spring, on the south bank of Red Deer River, four miles from its entry into Lake Winnipegosis. Collected September 9, 1889.

Water from spring on south bank of Red Deer River, district of Saskatchewan, North-west Territory.

Secific gravity, at 15·5°C., 1·039. It contained in 1000 parts, by weight:

| | |
|---|---|
| Potassium | 1·181 |
| Sodium | 18·524 |
| Calcium | 1·156 |
| Magnesium | 0·277 |
| Sulphuric acid ($SO_4$) | 2·812 |
| Chlorine | 29·805 |
| | 53·755 |
| Chlorine required, in addition to that found, to satisfy bases | 0·650 |
| | 54·405 |

Hypothetical combination:

| | |
|---|---|
| Chloride of potassium | 2·253 |
| " sodium | 47·114 |
| " magnesium | 1·061 |
| Sulphate of lime | 3·930 |
| " magnesia | 0·047 |
| | 54·405 |

Total dissolved solid matter, by direct experiment, dried at 180°C., 53·243.

It contained a trace of lithium. Barium, strontium, bromine and iodine were not sought for.

Remarks on composition of brines from Manitoba, and district of Saskatchewan, North-west Territory.

On referring to the several analyses it will be seen that all these brines contained a trace of lithium; also, that in the nine instances in which barium and strontium were sought for, the former was found to be absent in all, the latter present in two of them; and further, that of the seven examined for iodine and bromine, four contained a trace of the first mentioned, but no evidence of the presence of the latter was, in any instance, obtained.

The results of the analyses of the foregoing brines have, with the object of affording easy reference and facilitating a comparison the one with the other, been embodied in the following tables. In the first of these the amounts of the several constituents of the solid contents are expressed as parts by weight in one thousand parts by weight of the water, whilst the second shows the amounts, expressed as grains, of th various saline constituents contained in an imperial gallon of the wate The numbers heading the columns correspond with those assigned t the several analyses of these waters as given on the preceding page and under each of which will be found mentioned the locality occurrence of the various springs whence they were obtained.

## ANALYSES of Waters [illegible], and district of Saskatchewan, N.-W. Territory.

### CONSTITUENTS IN 1000 PARTS, BY WEIGHT, OF WATER

| Constituents. | 7. | 8. | 9. | 10. | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chloride of potassium | 2·473 | 2·879 | 1·887 | 1·992 | 1·158 | 2·473 | 2·099 | 0·685 | 0·319 | 1·916 | 1·587 | 2·253 |
| " sodium | 51·005 | 46·781 | 53·155 | 50·408 | 80·970 | 51·005 | 26·192 | 18·941 | 42·780 | 44·626 | 38·466 | 47·114 |
| " calcium | ......... | ......... | ......... | 0·108 | ......... | ......... | 0·219 | ......... | 0·608 | 0·144 | 0·394 | ......... |
| " magnesium | 1·176 | 1·399 | 0·649 | 1·299 | 1·686 | 1·120 | 1·116 | 0·823 | 1·963 | 1·077 | 1·401 | 1·061 |
| Sulphate of lime | 4·185 | 4·073 | 3·733 | 4·121 | 5·715 | 4·240 | 2·873 | 2·880 | 3·488 | 3·891 | 3·237 | 3·930 |
| " magnesia | 0·089 | 0·017 | 0·784 | ......... | 0·261 | 0·151 | ......... | 0·154 | ......... | ......... | ......... | 0·047 |
| Total | 58·928 | 55·149 | 60·208 | 57·928 | 89·790 | 58·989 | 32·499 | 23·483 | 49·158 | 51.654 | 45·085 | 54·405 |
| Specific gravity | 1·041 | 1·039 | 1·044 | 1·041 | 1·063 | 1·039 | 1·022 | 1·016 | 1·035 | 1·035 | 1·031 | 1·039 |

### GRAINS OF SALINE CONSTITUENTS IN ONE IMPERIAL GALLON OF WATER.

| Constituents. | 7. | 8. | 9. | 10. | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chloride of potassium | 180·21 | 209·39 | 137·90 | 145·16 | 86·17 | 179·86 | 150·16 | 48·72 | 23·11 | 138·81 | 114·59 | 163·86 |
| " sodium | 3716·73 | 3402·38 | 3884·57 | 3673·23 | 6024·98 | 3709·59 | 1873·78 | 1347·08 | 3099·41 | 3233·15 | 2777·44 | 3426·61 |
| " calcium | ......... | ......... | ......... | 7·87 | ......... | ......... | 15·67 | ......... | 44·05 | 10·43 | 28·45 | ......... |
| " magnesium | 85·69 | 101·75 | 47·43 | 94·66 | 125·46 | 81·46 | 79·84 | 58·53 | 142·22 | 78·03 | 101·16 | 77·17 |
| Sulphate of lime | 304·96 | 296·23 | 272·81 | 300·30 | 425·25 | 308·38 | 205·53 | 204·83 | 252·71 | 281·90 | 233·73 | 285·83 |
| " magnesia | 6·49 | 1·24 | 57·30 | ......... | 19·42 | 10·98 | ......... | 10·95 | ......... | ......... | ......... | 3·42 |
| Total | 4294·08 | 4010·99 | 4400·01 | 4221·22 | 6681·28 | 4290·27 | 2324·98 | 1670·11 | 3561·50 | 3742·32 | 3255·37 | 3956·89 |

Natural waters-*Con.*

The proportion of foreign saline matters in these brines is not excessive, and if certain purifying processes are had recourse to, there is no reason—local conditions being favourable—why they should not be utilized in the manufacture of salt.

Outline of methods pursued in the preparation of salt from its solutions.

The following brief outline of the methods pursued in the preparation of salt from its solutions, will serve to convey some idea of the expedients resorted to for the economical treatment of the weaker salt waters. The processes may be arranged under the following headings: 1. Those in which the evaporation is entirely effected by artificial heat ; 2. Those dependent upon natural evaporation—either wholly or in part ; 3. That in which concentration is effected by congelation—with subsequent recourse to artificial heat.

By artificial evaporation.

1. By artificial evaporation.

The manufacture of salt from its solutions by evaporation with artificial heat, is conducted either in large shallow iron pans—as in Cheshire, Worcestershire and Staffordshire,—or in kettles—as at the Onondaga salines, and elsewhere. The heating in both instances being effected by fires placed beneath.

By natural evaporation.

2. By natural evaporation—either wholly or in part.

(*a.*) By the influence of the sun, aided by that of the air—solar evaporation. This method is resorted to in the preparation of salt from sea water, on the shores of the Mediterranean, some parts of the English and Scottish coasts, and in some localities on the Atlantic and Pacific coasts of the United States. The evaporation is carried on in a series of shallow ponds or basins in which the water is spread over a very large surface. These reservoirs, which are excavated on the sea shore, are generally puddled with clay, but on the Bay of San Francisco the better grade of salt is prepared in ponds which are provided with wooden floors or wholly inclosed with boards, and when a specially pure salt is required, the cleanest of the brine is transferred to, and the evaporation completed in, wooden tanks. When solar evaporation is pursued in the manufacture of salt from natural brines, the process is conducted in a series of shallow wooden vats, arranged in tiers, provided with movable covers running upon rollers for use during rainy weather. The brine is let into the upper tier of vats and from thence is allowed, at different stages of alteration, to pass on until it ultimately arrives—having in the interval deposited suspended and nearly all the less soluble impurities, and lost a large proportion of its water by evaporation—as a clear saturated brine, in the lower tier of vats where the formation of salt goes on.

(*b.*) By exposure to a current of air—the " graduation " process. A method employed, among other places, at Moutiers in France, and at

Natural waters-*Con.*

Outline of methods pursued in the preparation of salt from its solutions-*Con.*

By natural evaporation-*Con.*

Nauheim, Dürrenberg, Rodenberg, and Schönebeck, in Germany, in the preparation of salt from weak brines. The process is carried on in what are termed "graduation-houses." These are large wooden structures covered over at the top to exclude rain, but left open at the sides to allow of free circulation of air through the building. The interior arrangements may, in a general way, be described as consisting of a large shallow wooden cistern, for the reception of the brine, over which are arranged bundles of brushwood or thorns built up in the form of a wall between wooden supports, and over this a reservoir for the weak brine. The saline water is pumped into the upper reservoir and thence allowed to trickle down over the surface or through the interstices of the thorns, thereby exposing it, diffused over a very large surface, to the influence of the air and effecting its concentration. The operation is repeated as often as may be found necessary for the conversion of the weak into a strong brine.

The success of these two processes, solar evaporation and "graduation," being altogether dependent upon the state of the atmosphere, their use is consequently limited to the more favourable time of the year.

3. By congelation.

By congelation.

In some parts of northern Europe the separation of salt from sea water is, in part, effected by the agency of frost—salt water when partially frozen separating into ice, retaining very little salt, and a proportionately strong saline liquor. So that by submitting sea water, contained in reservoirs, to repeated partial congelations and removing the ice as it forms, each successive mother liquor becomes more and more impregnated with salt, until at length the solution attains the strength of a saturated brine.

The process dependent upon evaporation with artificial heat is usually only resorted to in the treatment of strong brines, but where cheap fuel can be obtained the same plan is pursued with the waters of the weaker springs and sometimes, though rarely, even with sea water. When fuel is scarce the more dilute saline waters cannot be profitably worked in this way, and these can, therefore, only be utilized by resorting to one of the processes of natural evaporation—solar evaporation or that by "graduation." The salt may, by either of these methods, be prepared without the aid of artificial heat, as is customary in the preparation of "bay-salt" and "solar-salt," and is also the practice at the "graduation works" at Moutiers, in France, or the weak brine may be brought to the point of saturation and further evaporation effected with artificial heat. The concentrated liquor obtained by the repeated partial freezing of a weak salt water is treated as a strong brine, the salt being obtained from it by artificial evaporation.

Iron ores.

## IRON ORES.

Magnetite from Pine Creek, Waterton River, British Columbia.

1.—Magnetite. From Pine Creek, Waterton River, fifteen miles from forks of North Fork and Waterton River, British Columbia. Examined for Mr. John Herron.

Massive, very fine crystalline; colour, greyish-black. Mr. Wait found it to contain:

| | |
|---|---|
| Metallic iron | 55·62 per cent. |
| Insoluble matter | 9·36 " |
| Titanic acid | trace. |

Magnetite from location 400 R., Atic-okan River, Ontario.

2.—Magnetite. From location 400 R., Atic-okan River, Rainy River district, province of Ontario. This, and the five following specimens were collected by Dr. A. C. Lawson (Survey).

A massive magnetite. Determinations by Mr. Johnston gave:

| | |
|---|---|
| Metallic iron | 68·03 per cent. |
| Titanic acid | none. |

Magnetite from location 402 R., Atic-okan River, Ontario.

3.—Magnetite. From location 402 R., Atic-okan River, Rainy River district, province of Ontario.

Massive, fine-granular. Mr. Johnston found it to contain:

| | |
|---|---|
| Metallic iron | 68·58 per cent. |
| Titanic acid | none. |

Magnetite from location 403 R., Atic-okan River, Ontario.

4.—Magnetite. From location 403 R., Atic-okan River, Rainy River district, province of Ontario.

A fine-granular magnetite. Examined by Mr. Johnston it was found to contain:

| | |
|---|---|
| Metallic iron | 64·55 per cent. |
| Titanic acid | none. |

Magnetite from Sabawy Lake, Atic-okan River, Ontario.

5.—Magnetite. From two miles and a-half west of Sabawy Lake, Atic-okan River, Rainy River district, province of Ontario.

A massive magnetite. It was found by Mr. Johnston to contain:

| | |
|---|---|
| Metallic iron | 67·42 per cent. |
| Titanic acid | trace. |

Magnetite from line between locations 10 and 11 E., Atic-okan River, Ontario.

6.—Magnetite. From line between locations 10 E. and 11 E., Atic-okan River, Rainy River district, Province of Ontario.

Massive, fine-granular. Determinations by Mr. Johnston gave:

| | |
|---|---|
| Metallic iron | 65·71 per cent. |
| Titanic acid | none. |

**Iron ores—*Con.***

**Hematite from Black Sturgeon Lake, Ontario.**

7.—Hematite. An iron-black hematite from the south-east end of Black Sturgeon Lake, district of Thunder Bay, province of Ontario.

Agreeably with the results of an examination by Mr. Johnston, it contained:

| | |
|---|---|
| Metallic iron | 47·17 per cent. |
| Titanic acid | none. |

**Hematite from Sunnybrae, Pictou county, Nova Scotia.**

8.—Hematite. A sample of hematite from the vicinity of Sunnybrae, a mile and a-quarter north of the East River, Pictou county, Nova Scotia, examined by Mr. Johnston, was found to contain:

| | |
|---|---|
| Metallic iron | 50·63 per cent. |
| Phosphorus | 0·26 " |

**Hematite from Bastard, Leeds county, Ontario.**

9.—Hematite. From the township of Bastard, Leeds county, province of Ontario. The specimen, which was examined for Mr. Smith Curtis, was found, by Mr. Johnston, to contain:

| | |
|---|---|
| Metallic iron | 65·98 per cent. |

## NICKEL AND COBALT ORES.

**Nickel and cobalt ores.**

**Pyrrhotite from Barrachois Harbour, Cape Breton county, Nova Scotia.**

1.—Pyrrhotite. From the property of R. J. Nicholson, at Barrachois Harbour, Cape Breton county, Nova Scotia. Examined for Mr. Alex. McLeod.

The pyrrhotite, which was free from gangue, was examined by Mr. Johnston and found to contain:

| | |
|---|---|
| Nickel | trace. |
| Cobalt | none. |

**Pyrrhotite from near St Stephen, Charlotte county, New Brunswick.**

2.—Pyrrhotite. From what is stated to be an extensive deposit, three miles north of St. Stephen, Charlotte county, New Brunswick.

The material consisted of pyrrhotite, through which was disseminated a little copper-pyrites and a very small amount of quartzose gangue. A partial analysis, by Mr. Johnston, gave as follows:—

| | |
|---|---|
| Nickel | 1·72 per cent. |
| Cobalt | 0·16 " |
| Copper | 0·31 " |

or—calculated upon the material free from all gangue:

| | |
|---|---|
| Nickel | 1·82 per cent. |
| Cobalt | 0·17 " |
| Copper | 0·33 " |

Nickel and cobalt ores—*Con.*

Another sample of ore from this locality consisted of pyrrhotite, in a gangue composed of diorite and white sub-translucent quartz.

Pyrrhotite from L'Etete, Charlotte county, New Brunswick.

3.—Pyrrhotite. From L'Etete, Charlotte county, New Brunswick.

The sample consisted of pyrrhotite, with a little copper-pyrites, in a gangue of diorite. The pyrrhotite was found, by Mr. Johnston, to contain both nickel and cobalt. The material would appear to be precisely similar to that from the vicinity of St. Stephen. Both closely resemble much of the ore found in the Sudbury district, province of Ontario.

Pyrrhotite from Lake Mistassini, province of Quebec.

4.—Pyrrhotite. From the vicinity of Lake Mistassini, province of Quebec. Collected by Mr. Walter McOuat (Survey) in 1872.

The pyrrhotite, which was in a gangue of hornblendic schist, constituted seventy-three per cent, by weight, of the whole. Mr. Johnston found it to contain :

| | |
|---|---|
| Nickel | distinct trace. |
| Cobalt | distinct trace. |

Pyrrhotite from Potton, Brome county, province of Quebec.

5.—Pyrrhotite. From Lake Memphremagog mine, lot twenty-four, range eighteen, of the township of Potton, Brome county, province of Quebec. Collected by Dr. R. W. Ells (Survey).

There were two samples—the one consisted of an association of pyrrhotite, copper-pyrites, and iron-pyrites, through which was disseminated a small amount of gangue. The pyrrhotite constituted, approximately, seventy-seven, and the copper and iron-pyrites, about twenty per cent, by weight, of the whole. The other sample consisted almost exclusively of pyrrhotite ; copper and iron-pyrites were present but only in very small quantities. The pyrrhotite of both samples was examined by Mr. Johnston, and found to contain—the former, a very small amount, the latter, a trace, of nickel.

Pyrrhotite from Clarendon, Pontiac county, province of Quebec.

6.—Pyrrhotite. From lot twenty-four, range seven, of the township of Clarendon, Pontiac county, province of Quebec. Examined for Mr. W. A. Allan. The material does not, so far as is known, occur in quantity.

The pyrrhotite, which was free from gangue, was found by Mr. Johnston to contain :

| | |
|---|---|
| Nickel | 1·50 per cent. |
| Cobalt | trace. |

Nickel and cobalt ores *Con.*

.—Pyrrhotite. From location W. 7, east side of Waddell's Lake, district of Nipissing, Ontario. This, and the following specimen, was collected by Dr. R. Bell (Survey).

**Pyrrhotite from Waddell's Lake, Ontario.**

An association of a somewhat coarse granular pyrrhotite with a small quantity of copper-pyrites, in a gangue of greyish-green diorite. An analysis, by Mr. Johnston, showed it to contain:

| | |
|---|---|
| Nickel | 2·00 per cent. |
| Cobalt | none. |

The gangue constituted, approximately, forty per cent, by weight, of the whole. The metalliferous portion of the ore contained, therefore, about 3·3 per cent nickel.

.—Pyrrhotite. From Boucher's mine, north-east side of Lake Wahnapitae, district of Nipissing, Ontario.

**Pyrrhotite from Lake Wahnapitae, Ontario.**

An intimate association of copper-pyrites and pyrrhotite, in a gangue of greyish-green diorite. Determinations by Mr. Johnston gave:

| | |
|---|---|
| Nickel | 1·57 per cent. |
| Cobalt | none. |

The gangue constituted, approximately, twenty-five per cent, by weight, of the whole. The metalliferous portion of the ore contained, therefore, about 2·1 per cent nickel.

. Pyrrhotite. From McCormick's mine, north-west corner of lot twelve, range three, of the township of Neelon, district of Nipissing, Ontario. Collected by Mr. A. E. Barlow (Survey).

**Pyrrhotite from Neelon, Ontario.**

A somewhat coarse granular pyrrhotite, associated with small quantities of copper-pyrites. Agreeably with the results of determinations made by Mr. Johnston, it contained:

| | |
|---|---|
| Nickel | 3·10 per cent. |
| Cobalt | trace. |

0.—Pyrrhotite. From two miles north of the township of Lumsden, on the boundary line between the district of Nipissing and Algoma, Ontario. Examined for Mr. Christie Crites.

**Pyrrhotite from Lumsden, Ontario**

The material consisted of pyrrhotite in association with small quantities of dark green diorite. The pyrrhotite, free from gangue, was found, by Mr. Wait, to contain, approximately:

| | |
|---|---|
| Nickel | 2·7 per cent. |
| Cobalt | none. |

Nickel and cobalt ores—*Con.*

Pyrrhotite from Lorne, Ontario.

11.—Pyrrhotite. From O'Connor's claim, lot eleven, range five, of the township of Lorne, district of Algoma, Ontario. Collected by Mr. A. E. Barlow (Survey).

It consisted of pyrrhotite, together with a trifling amount of copper-pyrites, in association with a greyish-green diorite. The latter constituted but a small proportion, by weight, of the whole. Determinations by Mr. Johnston gave:

| | |
|---|---|
| Nickel | 1·95 per cent. |
| Cobalt | none. |

Pyrrhotite from Lorne, Ontario.

12.—Pyrrhotite. Another sample of material from the township of Lorne, consisting of pyrrhotite, together with a little copper-pyrites, in a gangue of greyish-green diorite, was found by Mr. Johnston to contain:

| | |
|---|---|
| Nickel | 1·57 per cent. |
| Cobalt | none. |

The gangue constituted thirty-three per cent, by weight, of the whole. The metalliferous portion of the ore contained, therefore, about 2·3 per cent nickel.

Pyrrhotite from Nairn, Ontario.

13.—Pyrrhotite. From O'Connor's claim, lots one and two, range three, of the township of Nairn, district of Algoma, Ontario. This, and the following specimen, was collected by Mr. A. E. Barlow (Survey).

The material consisted of pyrrhotite in association with a greyish-green diorite. The latter constituted but a small proportion, by weight, of the whole. An analysis, by Mr. Johnston, showed it to contain:

| | |
|---|---|
| Nickel | 1·95 per cent. |
| Cobalt | trace. |

Pyrrhotite from Drury, Ontario.

14.—Pyrrhotite. From Messrs. Loughran and Dwyer's claim, lot three, range three, of the township of Drury, district of Algoma, Ontario.

An association of pyrrhotite with a little copper-pyrites, through which was disseminated a trifling amount of a quartzose gangue. Agreeably with determinations conducted by Mr. Johnston, it contained:

| | |
|---|---|
| Nickel | 2·01 per cent. |
| Cobalt | trace. |

Pyrrhotite from Denison, Ontario.

15.—Pyrrhotite. From the south half of lot six, range two, of the township of Denison, district of Algoma, Ontario. This, and the five following specimens, were collected by Dr. R. Bell (Survey).

Nickel and cobalt ores—*Con.*

Pyrrhotite from Denison, Ontario—*Con.*

A somewhat coarse granular pyrrhotite, through which was disseminated a small amount of quartzose gangue. Determinations by Mr. Johnston gave :

| | |
|---|---|
| Nickel | 1·55 per cent. |
| Cobalt | none. |

The gangue constituted twelve and a-half per cent, by weight, of the whole. The metalliferous portion of the ore contained, therefore, about 1·8 per cent nickel.

Pyrrhotite from Levack, Ontario.

16.—Pyrrhotite. From lot seven, range two, of the township of Levack, district of Algoma, Ontario.

A somewhat coarse granular pyrrhotite, through which was disseminated a quartzose gangue. Mr. Johnston found it to contain :

| | |
|---|---|
| Nickel | 2·36 per cent. |
| Cobalt | trace. |

The gangue amounted to twenty-two per cent, by weight, of the whole. The metalliferous portion of the ore contained, therefore, about 3·0 per cent nickel.

Pyrrhotite from Levack, Ontario.

17.—Pyrrhotite. Also from lot seven, range two, of the township of Levack, district of Algoma, Ontario.

A very coarse granular pyrrhotite, free from gangue, was found by Mr. Johnston to contain :

| | |
|---|---|
| Nickel | 4·13 per cent. |
| Cobalt | none. |

Pyrrhotite from Levack, Ontario.

18.—Pyrrhotite. From lot three, range four, of the township of Levack, district of Algoma, Ontario.

A somewhat coarse granular pyrrhotite, together with a very small amount of copper-pyrites, in association with a greyish-green diorite. Determinations, conducted by Mr. Johnston, gave :

| | |
|---|---|
| Nickel | 1·96 per cent. |
| Cobalt | trace. |

The gangue constituted eighteen and a-half per cent, by weight, of the whole. The metalliferous portion of the ore contained, therefore, about 2·4 per cent nickel.

Pyrrhotite from Morgan, Ontario.

19.—Pyrrhotite. From the Ross mining location, three miles north of the northern township-line of the township of Morgan, district of Algoma, Ontario.

A coarse granular pyrrhotite, with which was associated a small amount of copper-pyrites. The gangue was not readily discernible.

**Nickel and cobalt ores—Con.**

**Pyrrhotite from Morgan, Ontario—C**

Agreeably with the results of determinations made by Mr. Johnston, it contained:

| | |
|---|---|
| Nickel | 2·75 per cent. |
| Cobalt | none. |

The gangue constituted sixteen and a-half per cent, by weight, of the whole. The metalliferous portion of the ore contained, therefore, about 3·3 per cent nickel.

**Pyrrhotite from Creighton, Ontario.**

20.—Pyrrhotite. From the property of Mr. James Stobie, on lot ten, range four, of the township of Creighton, district of Algoma, Ontario.

The material consisted of coarse granular pyrrhotite, in association with some zinc-blende, through which was disseminated a somewhat small amount of a dark grey schistose rock and white quartz. It was examined by Mr. Johnston and found to contain neither nickel nor cobalt. The gangue constituted sixteen per cent, by weight, of the whole.

**Nickeliferous ore from Vermilion mine, Denison, Ontario.**

21.—Nickeliferous ore from the Vermilion mine, lots five and six, range four, of the township of Denison, district of Algoma, Ontario. This, and the following specimen, was presented to Mr. A. E. Barlow by Mr. F. L. Sperry. The material was, in both instances, merely intended to represent certain portions of the ore occurring at this mine.

It consisted of an association of chalcocite and chalcopyrite, through which was disseminated some polydymite. Some of the fragments were coated and seamed with green carbonate of copper.

Agreeably with the results of determinations by Mr. Johnston, it contained:

| | |
|---|---|
| Nickel | 9·40 per cent. |
| Cobalt | none. |

**Nickel ore from Vermilion mine, Denison, Ontario.**

22.—Nickel ore from the Vermilion mine—same locality as the preceding specimen (*see* remarks made in connection therewith).

The material consisted of polydymite, together with a little chalcopyrite, in a gangue composed of diorite and small quantities of a white translucent quartz. Carefully selected material—which, however, it was ultimately found still contained a little intermixed gangue and chalcopyrite—was found by Mr. Johnston, to contain:

| | |
|---|---|
| Nickel | 40·80 per cent. |
| Cobalt | none. |

**Nickel and cobalt ores—*Con.***

Conformably with the results of an examination by F. W. Clarke and C. Catlett, who were the first to point out its occurrence in the ore of this mine, the mineral here met with is a ferriferous variety of the polydymite of Laspeyres and has, when free from all foreign admixture, the following composition:—nickel 43·18, iron 15·47, sulphur 41·35 = 100·00.

**Cobaltiferous arsenopyrite from Graham, Ontario.**

23.—Cobaltiferous arsenopyrite. A cobaltiferous mispickel containing 4·09 per cent of cobalt and 0·93 per cent of nickel, has been found in the workings of a nickeliferous pyrrhotite deposit on the north half of lot six, in the third range of the township of Graham, district of Algoma, Ontario. The complete analysis of this mineral is given under "Miscellaneous minerals" (No. 5, Danaite), *ante*.

It cannot, at present, be conjectured as to whether much of this ore is likely to be met with or not—should it occur in quantity it could be made available as a source of cobalt.

**Niccolite and Gersdorffite from Denison, Ontario.**

24.—Niccolite and Gersdorffite. From O'Connor's claim on lot twelve of the third range of the township of Denison, district of Algoma, Ontario. Collected by Mr. A. E. Barlow (Survey).

The material was not intended to represent an average of any portion of the ore of this claim—on the contrary, it was so selected as to ensure the obtaining of the best procurable specimens of the minerals in question. The sample, which was made up of some sixteen fragments and weighed, in the aggregate, twelve pounds and a quarter, may be described, as a whole, as consisting of an association of a light to dark green, fine grained, diabase with small quantities of a dark green chloritic, and a little light greenish-grey micaceous, schist, small quantities of a greyish-white to white translucent quartz and a trifling amount of calcite—containing, in parts, chalcopyrite, a little pyrrhotite, niccolite and, more or less intimately associated with the latter, Gersdorffite. No analysis was made of the niccolite. This, when pure, contains in one hundred parts 44·1 of nickel and 55·9 of arsenic; part of the arsenic being sometimes replaced by antimony. The Gersdorffite, however, was, in view of the fact that this mineral often varies greatly in its composition, submitted to analysis and found to contain 26·32 per cent of nickel and 2·01 per cent of cobalt. The complete analysis is given under "Miscellaneous minerals" (No. 9), *ante*.

**Pyrrhotite from Clarendon, Ontario.**

25.—Pyrrhotite. From the township of Clarendon, Frontenac county, Ontario.

Nickel and cobalt ores - *Con.*

Pyrrhotite from Clarendon, Ontario-*Con.*

A greyish-white gneissoid rock through which was disseminated a somewhat large amount of pyrrhotite. Agreeably with the results of determinations by Mr. Johnston, it contained:

| | |
|---|---|
| Nickel | trace. |
| Cobalt | 0·20 per cent. |

The gangue amounted to sixty per cent, by weight, of the whole. The metallic portion of the ore contained therefore, about 0·5 per cent of cobalt.

Pyrrhotite from near Schreiber, Ontario.

26.—Pyrrhotite. From an extensive deposit two miles west of Schreiber, on the line of the Canadian Pacific Railway, district of Thunder Bay, Ontario. Examined for Mr. Thomas Mark.

A massive pyrrhotite, free from gangue. On examination, by Mr. Johnston, it was found to contain:

| | |
|---|---|
| Nickel | 0·03 per cent. |
| Cobalt | trace. |

Pyrrhotite from near Schreiber, Ontario.

27.—Pyrrhotite. From the same locality as the preceding specimen. A fair average sample, collected by Dr. A. R. C. Selwyn. The material consisted of a fine granular, massive pyrrhotite, through which was disseminated a little quartzose gangue. The latter constituted, approximately, ten per cent, by weight, of the whole. Mr. Johnston found it to contain:

| | |
|---|---|
| Nickel | trace. |
| Cobalt | trace. |

Pyrrhotite from Darlington Bay, Lake of the Woods, Ontario.

28.—Pyrrhotite from Darlington Bay, Lake of the Woods, district of Rainy River, Ontario. Examined for Mr. Mather.

Consisted of pyrrhotite in association with a dark grey gneissoid rock. The latter constituted, approximately, twenty per cent, by weight, of the whole. It was found on examination by Mr. Johnston, to contain:

| | |
|---|---|
| Nickel | trace. |
| Cobalt | trace. |

Pyrrhotite from Barclay Sound, Vancouver Island, British Columbia.

29.—Pyrrhotite. From near the head of Barclay Sound, Vancouver Island, British Columbia. Examined for Capt. J. Jaques.

A massive pyrrhotite from this locality has been examined by Mr. Johnston, and found to contain:

| | |
|---|---|
| Nickel | trace. |
| Cobalt | trace. |

Nickel and cobalt ores—*Con.*

30.—Pyrrhotite. From Monashee mine, Monashee Mountain, near the head of Cherry Creek, British Columbia. Collected by Dr. G. M. Dawson (Survey).

Pyrrhotite from Monashee Mountain, British Columbia.

An association of white sub-translucent quartz and dark green diorite, carrying large quantities of pyrrhotite and a little copper-pyrites. On examination, by Mr. Johnston, it was found to contain:

| | |
|---|---|
| Nickel | none. |
| Cobalt | trifling amount. |

Occurrence of nickel and cobalt ores in other parts of Canada.

It may not be amiss to draw attention here to certain other nickel and cobalt ores, or minerals containing a noteworthy amount of one or the other of these metals, which have from time to time been met with in Canada in the course of this Survey's work.

One of these, described as a steel-grey pyritous ore, from the Wallace mine on Lake Huron, was found by Dr. T. S. Hunt to contain 13·93 per cent of nickel. Of two others found on Michipicoten Island, Lake Superior, the one was shown by Dr. Hunt to be an intimate mixture of the arseniurets of copper and nickel; different portions of the same mass affording him from 17·03 to 36·39 per cent of nickel, whilst the other, also examined by Dr. Hunt, proved to be a hydrated silicate of nickel which, after drying at 100°C., was found by him to contain 30·40 per cent oxide of nickel (equivalent to 23·91 per cent nickel). The arsenide of nickel, which for present purposes may be regarded as consisting of 44·1 of nickel and 55·9 of arsenic, has also been found at the 3A mine, on lot 3A of the township of McGregor, district of Thunder Bay, where it occurs in somewhat large nodular grains and nugetty bunches, together with native silver, of a similar form, freely disseminated through a gangue of calcspar with some quartz. The foregoing are all rich ores of nickel, and should the deposits on further exploration be found to yield a sufficiency of the material these would, as available sources of this metal, prove of economic importance,

Less important, by reason of their occurring only in limited quantity or as containing but a relatively small amount of nickel or cobalt, are the following:—Millerite or nickel sulphide, a rich and valuable ore of nickel, occurs in small grains and prismatic crystals disseminated through a mixture of chrome-garnet and calcspar in a vein on the east side of Brompton Lake, in the township of Orford, province of Quebec. It is also reported to have been observed, in the form of prismatic crystals, disseminated through certain portions of the nickeliferous ore of the Copper Cliff mine, in the township of McKim, district

Nickel and cobalt ores—*Con.*

Occurrence of nickel and cobalt ores in other parts of Canada—*Con.*

of Nipissing, Ontario. Erythrite or hydrous cobalt arsenate, a valuable ore of cobalt when met with in quantity, is mentioned by Dr. Hunt as occurring in rose-red incrustations on calcareous spar at Prince's mine on Lake Superior. Smaltite, a cobalt arsenide, was oberved by Mr. E. B. Kenrick in the form of minute crystals in a sample of copper pyrites (brought to the Survey for examination) from the township of McKim, district of Nipissing, Ontario. A sample of iron-pyrites from the seigniory of Daillebout, Joliette county, province of Quebec, was found by Dr. Hunt to contain 0·55 per cent of oxide of nickel (equivalent to 0·43 nickel) mixed with cobalt, and a brilliant compact variety of iron-pyrites from Elizabethtown, Leeds county, Ontario, yielded him from 0·5 to 0·6 per cent oxide of cobalt (equivalent to 0·39 to 0·47 cobalt), whilst a sample of iron-pyrites from Londonderry, Nova Scotia, was found by me (Rep. Geol. Surv. Can., 1874–75, p. 316) to contain 0·81 per cent of cobalt and 0·14 per cent of nickel.

Gold and silver assays.

## GOLD AND SILVER ASSAYS.

*These were, with but one exception (No. 36), all conducted by Mr. R. A. A. Johnston.*

### PROVINCE OF NOVA SCOTIA.

Province of Nova Scotia

1.—From the Caledonia gold-field, Queen's county.

The material, which consisted of finely crushed tailings, was found, on assay, to contain :

Gold.......... 0·073 of an ounce to the ton of 2,000 lbs.
Silver......... 0·131 " " "

2.—From the farm of Donald McDonald, North River, St. Ann's, Victoria county. Examined for Mr. B. E. Tremaine.

White sub-translucent quartz carrying a somewhat large amount of zinc-blende, and small quantities of galena, copper-pyrites and iron-pyrites. The sample, which consisted of four pieces, weighed twelve ounces. Assays gave :

Gold............... trace.
Silver.............. 0·467 of an ounce to the ton of 2,000 lbs.

3.—From the farm of John McDonald. Same locality as the preceding specimen. Examined for Mr. B. E. Tremaine.

Consisted of an association of white sub-translucent quartz and iron-pyrites. Weight of sample, one pound three ounces. It contained :

Gold and silver assays—Con.

| | |
|---|---|
| Gold........... | trace. |
| Silver.......... | 0·583 of an ounce to the ton of 2,000 lbs. |

Province of Nova Scotia—Con.

4.—From railway cutting at mouth of Bear River, Digby county. Examined for Mr. H. F. Sims.

A quartzo-felspathic rock carrying zinc-blende and copper-pyrites. The sample, which consisted of numerous fragments, weighed thirteen ounces.

It contained neither gold nor silver.

5.—From the same locality as the last mentioned, and examined for the same person.

A white to greyish-white sub-translucent quartz carrying large quantities of zinc-blende and copper-pyrites. It was found to contain :

| | |
|---|---|
| Gold.................................. | trace. |
| Silver.... ............................. | trace. |

6.—This, and the following specimen, is from the Brookfield gold-field, Colchester county.

Specimen from near barytes pit, Brookfield. A somewhat ferruginous quartz conglomerate. Weight of sample, two pounds two ounces.

It contained neither gold nor silver.

7.—Specimen from three hundred yards above old mill, Pembroke. A coarse quartz conglomerate. Weight of sample, two pounds twelve ounces.

It contained neither gold nor silver.

## PROVINCE OF NEW BRUNSWICK.

Province of New Brunswick.

8.—From a vein on Millstream, about two miles from the iron ore deposit, fifteen miles from Bathurst, and about seven miles in a direct line from the line of the Intercolonial Railway, Gloucester county. Examined for Mr. W. R. Payne.

It consisted of iron-pyrites, together with small quantities of galena, and, apparently, trifling amounts of mispickel, in a gangue composed of white to grey, sub-translucent quartz, and a little

Gold and silver assays—*Con.*

dark grey shale. A fair average of this particular specimen—which weighed eleven pounds—was found, on assay, to contain:

| | |
|---|---|
| Gold | 0·175 of an ounce to the ton of 2,000 lbs. |
| Silver | 9·450 ounces " " |

Province of Quebec.

## PROVINCE OF QUEBEC.

9.—From lot twenty-five, range three, of the township of Ascot, Sherbrooke county. Examined for Mr. J. A. Chicoyne.

An association of a greenish-grey chloritic schist and dolomite, carrying a very large quantity of iron-pyrites.

It contained neither gold nor silver.

10.—From the Garthby mine, township of Garthby, Wolfe county.

A fine grained iron-pyrites through which was disseminated a small quantity of copper-pyrites. Weight of sample, two pounds. It was found to contain:

| | |
|---|---|
| Gold | very distinct trace. |
| Silver | trace. |

11.—From lot nine, range nine, of the township of Wakefield, Ottawa county. Examined for the Rev. C. Gay.

A bluish-white to white, opalescent quartz, through which was disseminated a few grains of iron-pyrites and a few scales of yellowish-white mica. The specimen was more or less seamed with hydrated peroxide of iron. Assays gave:

| | |
|---|---|
| Gold | trace. |
| Silver | none. |

12.—From lot twenty-seven, Kennebec road, of the township of Linière, Beauce county. Examined for Mr. L. G. Gendreau.

A white sub-translucent quartz, carrying appreciable quantities of iron-pyrites, and small quantities of copper-pyrites and galena. Weight of sample, one pound four ounces. Assays showed it to contain:

| | |
|---|---|
| Gold | none. |
| Silver | 34·767 ounces to the ton of 2,000 lbs. |

13.—From a seam traversing a vein of green apatite on lot eleven, range five, of the township of Templeton, Ottawa county. Examined for Mr. Hector McRae.

Gold and silver assays - *Con.*

The iron-pyrites, which composes the seam in question, freed from gangue, was found, on assay, to contain :

| | |
|---|---|
| Gold | trace. |
| Silver | none. |

## PROVINCE OF ONTARIO.

Province of Ontario.

.—From Hybla, Hastings county. Examined for Mr. G. Bartlett.

An association of iron-pyrites and magnetic-pyrites, in a gangue composed of calcite and white sub-translucent quartz. The gangue constituted but a small proportion, by weight, of the whole. Weight of sample, two pounds ten ounces.

It contained neither gold nor silver.

.—From lot nineteen, range three, of the township of Darling, Lanark county. Examined for Mr. R. McGregor.

White sub-translucent quartz carrying small quantities of iron-pyrites. The quartz was more or less honeycombed; the cavities containing hydrated peroxide of iron. The sample, consisting of two pieces, weighed seven ounces.

It contained neither gold nor silver.

.—From the property of the Anglo-Canadian Phosphate Company, north-east corner of lot three, range eight, of the township of North Burgess, Lanark county. Examined for Capt. R. C. Adams.

A white pegmatite, composed of felspar and quartz, containing a few grains of iron-pyrites. The sample, consisting of one piece, weighed, two pounds ten ounces.

It contained neither gold nor silver.

7.—From lot twenty-five, range five, of the township of Darling, Lanark county. Examined for Mr. R. McGregor.

A white sub-translucent to dark grey quartz, with which was associated a small quantity of magnetite. It carried large quantities of iron-pyrites and small quantities of magnetic-pyrites, copper-pyrites and bornite. The sample, consisting of eight fragments, weighed seventeen ounces. Assays gave :

| | |
|---|---|
| Gold | distinct trace. |
| Silver | none. |

**Gold and silver assays—*Con.***

**Province of Ontario—*Con.***

18.—From the west half of lot twenty-two, range four, of the township of Darling, Lanark county. Examined for Mr. J. Craig.

An association of white sub-translucent quartz with a white fine grained dolomite, carrying small quantities of bournonite and copper-pyrites. The sample, composed of three pieces, weighed seven ounces and a-half. It was found to contain :

Gold........... 0·116 of an ounce to the ton of 2.000 lbs.
Silver.......... 5·176 ounces " "

19.—From lot seven, range four—near east line, half a mile from south-east corner post—of the township of Drury, district of Algoma.

A greyish-white quartz, more or less stained with hydrated peroxide of iron, carrying a somewhat large amount of copper-pyrites. The sample, which consisted of eight fragments, weighed fourteen ounces and a-half. It was found to contain :

Gold ........... trace.
Silver...... .... 0·583 of an ounce to the ton of 2,000 lbs.

20.—This, and the seven following specimens are from lot thirty-two, range two, of the township of Chandos, Peterborough county. They were examined for Mr. C. P. Cameron.

Copper-pyrites in a gangue of coarsely crystalline limestone. It contained :

Gold ......... distinct trace.
Silver..... .... 0·233 of an ounce to the ton of 2,000 lbs.

21.—Copper-pyrites together with a little iron-pyrites, in a gangue of coarsely crystalline limestone. Assays gave :

Gold........... distinct trace.
Silver.... ..... 0·933 of an ounce to the ton of 2,000 lbs.

22.—Grey felstone carrying small quantities of copper-pyrites. It was found to contain :

Gold........... trace.
Silver...... .... 0·116 of an ounce to the ton of 2,000 lbs.

23.—A more or less weathered felstone, carrying small quantities of iron-pyrites. Assays showed it to contain :

Gold.................. .................. trace.
Silver........................ .... ....... none.

24.—An association of limestone and felstone, carrying small quantities of copper-pyrites. Assays gave :

Gold and silver assays—*Con.*

Province of Ontario—*Con.*

Gold ........... distinct trace.
Silver.......... 0·291 of an ounce to the ton of 2,000 lbs.

25.—Iron-pyrites in a gangue composed of white, coarse crystalline calcite and grey felstone. It contained :

| | |
|---|---|
| Gold..................................... | trace. |
| Silver..................................... | none. |

26.—An association of white limestone and grey felstone together with a little mica, through which was disseminated small quantities of iron-pyrites. It was found to contain :

Gold........... trace.
Silver.......... 0·116 of an ounce to the ton of 2,000 lbs.

27.—A slightly calcareous gneissoid rock, through which was disseminated a few scales of graphite.

It contained neither gold nor silver.

28.—From the vicinity of Algoma Mills, township of Long, district of Algoma. Examined for Mr. W. A. Allan.

An association of white sub-translucent quartz with small quantities of greyish-green chloritic schist, more or less stained and coated with hydrated peroxide of iron, carrying small quantities of iron-pyrites, copper-pyrites and bornite. It was found on assay to contain :

Gold.......... trace.
Silver.......... 0·233 of an ounce to the ton of 2,000 lbs.

29.—From ten miles north of Schreiber, on the line of the Canadian Pacific Railway, district of Thunder Bay, Lake Superior. This, and the following specimen, was examined for Sir James Grant·

Consisted of an association of dark green chloritic schist, with white sub-translucent quartz and a little felspar, carrying small quantities of zinc-blende and galena, and a little copper-pyrites. Weight of sample, which consisted of six pieces, fourteen ounces. Assays showed it to contain :

Gold........... none.
Silver.... ..... 0·117 of an ounce to the ton of 2,000 lbs.

**Gold and silver assays—*Con.***

**Province of Ontario—*Con.***

30.—From the same locality as the last.

A greyish-white dolomitic limestone, through which was disseminated small quantities of iron-pyrites. The sample, consisting of eight fragments, weighed one pound thirteen ounces. It was found to contain:

| | |
|---|---|
| Gold... ....... | 0·117 of an ounce to the ton of 2,000 lbs. |
| Silver.......... | 0·583 " " " |

31.—From the north-east quarter of lot three, range three, of the township of McGregor, district of Thunder Bay, Lake Superior. This, and the three following specimens, were examined for Mr. A. L. Bain.

A greyish-white quartz, through which was disseminated a somewhat large amount of iron-pyrites. The quartz was, in parts, cavernous, the cavities holding a yellowish and reddish-brown coloured ochre. Weight of sample, one pound three ounces. It contained:

| | |
|---|---|
| Gold............ | trace. |
| Silver.......... | 0·406 of an ounce to the ton of 2,000 lbs. |

32.—From lot six, Donelly's survey, of the township of McTavish, district of Thunder Bay, Lake Superior.

An association of white, greyish and amethystine quartz with a small quantity of a reddish coloured barite, carrying small quantities of copper-pyrites and a little galena. Weight of sample, one pound nine ounces. Assays gave:

| | |
|---|---|
| Gold............ | trace. |
| Silver.......... | 0·173 of an ounce to the ton of 2,000 lbs. |

33.—From the same locality as the last, but from a different vein.

A fine crystalline galena in a gangue composed of white sub-translucent quartz and reddish coloured felspar. Weight of sample, one pound fourteen ounces. It was found to contain:

| | |
|---|---|
| Gold........... | none. |
| Silver.......... | 0·729 of an ounce to the ton of 2,000 lbs. |

34.—From the same locality, but from a different vein, to the two preceding.

An association of calcite and white sub-translucent, together with a little amethystine quartz, carrying small quantities of zinc-blende. Weight of sample, six ounces. Assays showed it to contain:

| | |
|---|---|
| Gold....................................... | trace. |
| Silver...................................... | trace. |

## PROVINCE OF BRITISH COLUMBIA.

Gold and silver assays—*Con.*

Province of British Columbia.

Of the following—

*Specimens Nos. 35–47 are from the East Kootanie district.*
" *48–52* " *West* "
" *53–81* " *Interior plateau region*
" *82–88* " *Coast Ranges and coast region.*
*(Specimens Nos. 48–51 and 59–79 were collected by Dr. G. M. Dawson.)*

35.—From Wild Horse Creek, Upper Kootanie River, East Kootanie district.

It consisted essentially of tetrahedrite in a siliceous gangue. The latter constituted, approximately, sixty-four per cent, by weight, of the whole. Weight of sample, which consisted of numerous fragments, three ounces. It contained :

| | |
|---|---|
| Gold | 2·392 ounces to the ton of 2,000 lbs. |
| Silver | 224·700 " " |

The tetrahedrite, free from all gangue would, therefore, contain :

| | |
|---|---|
| Gold | 6·644 ounces to the ton of 2,000 lbs. |
| Silver | 624·166 " " |

36.—From Copper Creek—East Kootanie district.

An association of galena, zinc-blende and iron-pyrites, in a gangue of quartz. It was stained, and, in parts, coated with hydrated peroxide of iron and a little carbonate of lead. The sample, which consisted of ten fragments, weighed four pounds. It was found, by Mr. F. G. Wait, to contain :

| | |
|---|---|
| Gold | trace. |
| Silver | 33·25 ounces to the ton of 2,000 lbs. |

37.—From St. Mary's River, about ten miles from Fort Steele—East Kootanie district.

It consisted of an association of iron and copper-pyrites, in a gangue of white sub-translucent quartz. It was in parts coated with hydrated peroxide of iron and blue and green carbonate of copper. The gangue constituted but a small proportion, by weight, of the whole. Weight of sample, one and a-half ounces. Assays gave :

| | |
|---|---|
| Gold | trace. |
| Silver | 1·076 ounce to the ton of 2,000 lbs. |

**Gold and silver assays—*Con.***

**Province of British Columbia—*Con.***

38.—This, and the three following specimens, are from Bugaboo Creek which flows into the Spilimichine River, near Golden—East Kootanie district.

From "mother" lode. Consisted of iron-pyrites in a gangue of white sub-translucent quartz. Weight of sample, two pounds eight ounces. It contained:

Gold........... 0·058 of an ounce to the ton of 2,000 lbs.
Silver.......... 0·233 " "

39.—From "mother" lode. An association of iron-pyrites and arsenical-pyrites, in a gangue of white sub-translucent quartz. Weight of sample, seven ounces and a-half. Assays showed it to contain:

Gold.......... distinct trace.
Silver.......... 0·350 of an ounce to the ton of 2,000 lbs.

40.—From "Albion" mine. Magnetic-pyrites in association with a little copper-pyrites. Weight of sample, thirteen ounces. It was found to contain:

Gold........... none.
Silver.......... 0·117 of an ounce to the ton of 2,000 lbs.

41.—From "Albion" mine. Consisted of galena in a gangue of white quartz. Weight of sample, one pound four ounces. Assays gave:

Gold............... trace.
Silver............. 45·208 ounces to the ton of 2,000 lbs.

42.—From the "Syenite Bluff" claim, Deception Creek, Spilimichine River, twenty-seven miles from Golden—East Kootanie district. This, and the following specimen, was examined for Mr. J. McFatchie.

A somewhat coarse crystalline galena with which was associated a trifling amount of iron-pyrites. Weight of sample, seven ounces and a-half. Assays showed it to contain:

Gold............. trace.
Silver............... 107·187 ounces to the ton of 2,000 lbs.

43.—From the same claim as the last.

An association of a fibrous galena with zinc-blende, in a gangue of white sub-translucent quartz. Weight of sample, six ounces and a-half. It contained:

Gold............ 0·762 of an ounce to the ton of 2,000 lbs.
Silver........... 2·916 ounces " "

Gold and silver assays—*Con.*

Province of British Columbia—*Con.*

44.—From the "Law's" claim, Horse Thief Creek, Columbia River, ninety miles south of Golden—East Kootanie district. This, and the three following specimens, were examined for Mr. W. A. Baillie Grohman.

Consisted of iron-pyrites associated with small quantities of tetrahedrite and white sub-translucent quartz. The specimen was coated with hydrated peroxide of iron, and some blue and green carbonate of copper. Weight of sample, fourteen ounces. It was found to contain:

| | |
|---|---|
| Gold........... | 0·233 of an ounce to the ton of 2,000 lbs. |
| Silver.......... | 31·792 ounces " " |

45.—From Vermont Creek, vicinity of Golden—East Kootanie district.

An exteriorly weathered fragment of tetrahedrite. Weight of sample, one pound eleven ounces. Assays showed it to contain:

| | |
|---|---|
| Gold.............. | very distinct trace. |
| Silver.... ....... | 25·521 ounces to the ton of 2,000 lbs. |

46.—From the same locality as the last.

Galena associated with small quantities of tetrahedrite and quartz. Weight of sample, six ounces. It was found, on assay, to contain:

| | |
|---|---|
| Gold....... ..... | trace. |
| Silver............ | 164·792 ounces to the ton of 2,000 lbs. |

47.—From the same locality as the two preceding.

Consisted of galena in association with small quantities of tetrahedrite and a little quartz. Weight of sample, nine ounces. It contained:

| | |
|---|---|
| Gold.............. | trace. |
| Silver............ | 290·208 ounces to the ton of 2,000 lbs. |

48.—From north bank of Kootanie River, at Ward's ferry, about half a mile below the lower fall—West Kootanie district.

A very fine crystalline magnetite seamed with quartz, the latter carrying a very appreciable amount of iron-pyrites. Weight of sample, one pound one ounce. An assay of the pyritous quartz, which constituted about one-third, by weight, of the whole, showed that:

It contained neither gold nor silver.

Gold and silver assays—*Con.*

Province of British Columbia—*Con.*

49.—From copper claim opposite 49 Creek, Kootanie River—West Kootanie district.

Consisted of copper-pyrites, in association with a grey, hornblendic rock. The gangue constituted but a small proportion, by weight, of the whole. Weight of sample, twelve ounces. Assays gave :

| | |
|---|---|
| Gold................ | trace. |
| Silver............... | 1·400 ounce to the ton of 2,000 lbs. |

50.—From a quartz vein, two feet wide, traversing argillaceous schists, eight miles from the lower end, east side, of Upper Arrow Lake —West Kootanie district.

A white sub-translucent quartz, through which was disseminated a little iron-pyrites.

It contained neither gold nor silver.

51.—From a quartz vein traversing mica schist at mouth of river at north-west angle, north end, of Kootanie Lake—West Kootanie district.

A greyish-white sub-translucent quartz, through which was disseminated a few scales of mica, stained and, in parts, coated with hydrated peroxide of iron. Weight of sample, three pounds.

It contained neither gold nor silver.

52.—From Gold Hill, Illecillewaet—West Kootanie district. Collected by Dr. A. R. C. Selwyn.

A fine crystalline galena. Weight of sample, nine ounces. It was found to contain :

| | |
|---|---|
| Gold................ | trace. |
| Silver............... | 5·866 ounces to the ton of 2,000 lbs. |

53.—From Duck Lake (A. Postill), Okanagan—Interior plateau region. This, and the four following specimens, were examined fo[illegible] Mr. J. W. Mackay.

An association of calcite and greyish-green chloritic rock matte[illegible] Weight of sample, four ounces. Assays gave :

| | |
|---|---|
| Gold............ | trace. |
| Silver........... | 0·175 of an ounce to the ton of 2,000 lbs. |

54.—From Cherry Bluff, Kamloops Lake—Interior plateau region.

Magnetite, with which was associated a small amount of greyi[illegible]h-green hornblende. Weight of sample, eight ounces and a-h[illegible]lf. It contained :

| | |
|---|---|
| Gold.......... | trace. |
| Silver......... | 0·116 of an ounce to the ton of 2,000 lbs. |

Gold and silver assays *Con.*

Province of British Columbia-*Con.*

55.—From the Lower Nicola, near Coutlees—Interior plateau region.

Consisted of specular iron ore. Weight of sample, three ounces. Assays showed it to contain:

| | |
|---|---|
| Gold.......... | trace. |
| Silver......... | 0·175 of an ounce to the ton of 2,000 lbs. |

56.—From Foster's Bar, Fraser River—Interior plateau region.

Consisted of native arsenic, seamed with white sub-translucent quartz. Weight of sample, half an ounce. Assays gave:

| | |
|---|---|
| Gold.......... | none. |
| Silver......... | 0·729 of an ounce to the ton of 2,000 lbs. |

57.—From a two-foot lode on Cedar Creek, Indian reserve, west shore of Okanagan Lake, about ten miles south-west from the head of the lake—Interior plateau region.

A white sub-translucent quartz, stained and coated with hydrated peroxide of iron. It contained, in parts, a little iron-pyrites. Weight of sample, one pound three ounces. It was found to contain:

| | |
|---|---|
| Gold.......... | none. |
| Silver......... | 0·292 of an ounce to the ton of 2,000 lbs. |

58.—Found on branch entering Eagle River from the north-west, near Sicamous, Shuswap Lake—Interior plateau region. Examined for Mr. J. Butler.

It consisted of a white sub-translucent quartz, in parts, stained and coated with hydrated peroxide of iron and blue and green carbonate of copper, carrying small quantities of tetrahedrite. The latter constituted 3·38 per cent of the whole. Weight of sample, two ounces. The tetrahedrite was carefully freed from gangue and on being submitted to assay found to contain:

| | |
|---|---|
| Gold.......... | none. |
| Silver......... | 902·446 ounces to the ton of 2,000 lbs. |

Had this particular sample of the ore been assayed as received, the results would have been:

| | |
|---|---|
| Gold.......... | none. |
| Silver......... | 30·503 ounces to the ton of 2,000 lbs. |

59.—From Edward's Creek, North Thompson River—Interior plateau region.

**Gold and silver assays—*Con.***

A grey granite, through which was disseminated a few grains of iron-pyrites, in parts stained with hydrated peroxide of iron. Weight of sample, one pound two ounces. It contained :

**Province of British Columbia—*Con.***

| | |
|---|---|
| Gold | trace. |
| Silver | none. |

60.—From an extensive deposit of pyritous schists and quartzites. A quarter of a mile west from waggon road and four and a-half miles south from Cornwall's, Thompson River—Interior plateau region.

Quartzite, with fissures holding hydrated peroxide of iron. Weight of sample, two pounds and a-half. Assays gave :

| | |
|---|---|
| Gold | none. |
| Silver | trace. |

61.—From the same deposit as the last mentioned. A quarter of a mile east from waggon road and four and a-half miles south from Cornwall's, Thompson River—Interior plateau region.

A quartzose rock thickly coated with hydrated peroxide of iron. Weight of sample, four pounds three ounces. It was found to contain :

| | |
|---|---|
| Gold | trace. |
| Silver | none. |

62.—From a mile and a-half west of Stump Lake, Nicola valley—Interior plateau region.

A somewhat honeycombed quartzite, in parts coated with hydrated peroxide of iron. It contained :

| | |
|---|---|
| Gold | trace. |
| Silver | trace. |

63.—From Lillooet Mountain—Interior plateau region.

A slightly honeycombed felsite, carrying small quantities of iron-pyrites, stained and coated, with hydrated peroxide of iron. Weight of sample, three pounds.

It contained neither gold nor silver.

64.—From foot of Nicola Mountain, one mile and a-half east of bridge at lower end of Nicola Lake—Interior plateau region.

A highly weathered rust-stained rock. Weight of sample, one pound one ounce.

It contained neither gold nor silver.

Gold and silver assays—*Con.*

Province of British Columbia—*Con.*

65.—From the east side, and near the north end of Napier Lake—Interior plateau region.

A grey schistose rock through which was disseminated numerous specks of iron-pyrites. Weight of sample, three pounds six ounces.

It contained neither gold nor silver.

66.—From the Fraser River, west side, three miles above Fountain Creek—Interior plateau region.

A ferruginous dolomitic rock with an incrustation of crystalline calcite. Weight of sample, one pound four ounces.

It contained neither gold nor silver.

67.—From Glen Hart, about six miles from Clinton—Interior plateau region.

An association of white dolomite with white sub-translucent quartz, containing, here and there, a little partially weathered iron-pyrites. Weight of sample, one pound nine ounces. Assays gave:

| | |
|---|---|
| Gold | trace. |
| Silver | none. |

68.—From close to waggon road along Bonaparte River—Interior plateau region.

A highly weathered rust-stained rock. Weight of sample, one pound eight ounces.

It contained neither gold nor silver.

69.—From east side Fraser cliffs, opposite Lillooet bridge, and about a quarter of a mile back from the river—Interior plateau region.

A weathered calcareous conglomerate. Weight of sample, one pound nine ounces.

It contained neither gold nor silver.

70.—From the Thompson River, west side, nearly opposite Nicoamen—Interior plateau region.

A greenish-grey to white sub-translucent quartz, through which was disseminated a few specks of iron-pyrites. The specimen was more or less stained and coated with hydrated peroxide of iron. Weight of sample, one pound five ounces.

It contained neither gold nor silver.

**Gold and silver assays—*Con.***

**Province of British Columbia—*Con.***

71.—From Clinton Creek, just above Clinton—Interior plateau region.

A dark grey basalt, thickly coated with hydrated peroxide of iron. Weight of sample, one pound one ounce. It contained:

| | |
|---|---|
| Gold | trace. |
| Silver | none. |

72.—From the same locality as the preceding specimen.

An association of white crystalline quartz and wad. Weight of sample, fifteen ounces.

It contained neither gold nor silver.

73.—Found loose in gravel at Clinton—Interior plateau region.

A reddish-white, and purple mottled quartz, in parts coated with carbonate of lime and hydrated peroxide of iron. Weight of sample, one pound two ounces.

It contained neither gold nor silver.

74.—From one mile along road eastward from Fountain Creek—Interior plateau region.

Greyish-white quartzite, stained and coated with hydrated peroxide of iron, and carrying a few specks of iron-pyrites. Weight of sample, one pound eight ounces.

It contained neither gold nor silver.

75.—From west side of Fraser River, between Bridge River and Chilcotin, near base of coast ranges—Interior plateau region.

An intimate association of white sub-translucent quartz, dolomite and fibrous calcite. It was stained with hydrated peroxide of iron and blue and green carbonate of copper. Weight of sample, one pound.

It contained neither gold nor silver.

76.—From west side of Fraser River, four miles above Leon Creek—Interior plateau region.

White, opaque to sub-translucent quartz, with inclusion of a dark grey quartzite, more or less stained with hydrated peroxide of iron. Weight of sample, one pound ten ounces.

It contained neither gold nor silver.

77.—From seven miles and a-half north of Clinton—Interior plateau region.

Gold and silver assays—*Con.*

Province of British Columbia-*Con.*

Grey to dull red quartzite. Weight of sample, one pound. It was found to contain :

| | |
|---|---|
| Gold | trace. |
| Silver | none. |

78.—From near tunnel "Bonanza" location, Cayoosh Creek, Lillooet, Fraser River—Interior plateau region.

A dark grey schistose rock. Weight of sample, one pound.

It contained neither gold nor silver.

79.—Concentrates from mill at "Big Slide" mine, mouth of Kelly Creek, Fraser River—Interior plateau region.

Consisted of finely crushed iron-pyrites, with a small quantity of copper-pyrites and a little siliceous matter. It was found, on assay, to contain :

| | |
|---|---|
| Gold | 0·408 of an ounce to the ton of 2,000 lbs. |
| Silver | 0·933 " " " |

80.—From a vein on Thompson River, one mile west of Thompson siding, between Lytton and Drynoch—Interior plateau region. Examined for Mr. J. Wilson.

Greyish sub-translucent quartz carrying small quantities of iron-pyrites. Weight of sample, three ounces and a quarter.

It contained neither gold nor silver.

81.—From vicinity of Spence's Bridge, Thompson River—Interior plateau region. Examined for Mr. J. Murray.

Consisted of gypsum, through which was disseminated a very appreciable amount of iron-pyrites. Weight of sample, eleven ounces and a-half.

It contained neither gold nor silver.

82.—From the "Silver Point" claim, two miles and a-half up, and on the west bank of Cayoosh Creek—Coast Ranges and coast region. Examined for Mr. J. Butler.

A greyish-white dolomite in association with small quantities of calcite and white opaque quartz. Weight of sample, one pound ten ounces. It contained :

| | |
|---|---|
| Gold | none. |
| Silver | trace. |

Gold and silver assays—*Con.*

Province of British Columbia—*Con.*

83.—From above Siwash Creek, eight miles east of Yale—Coast Ranges and coast region. Examined for Mr. G. D. Rodney.

An association of quartz and dolomite, through which was disseminated, in fine particles, small quantities of iron-pyrites and magnetic-pyrites. Weight of sample, one pound. Assays gave:

| | |
|---|---|
| Gold | trace. |
| Silver | none. |

84.—From Cameron's Bar, Fraser River, between Hope and Yale—Coast Ranges and coast region. Examined for Mr. J. W. Mackay.

An intimate association of galena and zinc-blende. Weight of sample, four ounces and a-half. It was found to contain:

| | |
|---|---|
| Gold | trace. |
| Silver | 6·562 ounces to the ton of 2,000 lbs. |

85.—From "Silver" claim, Bowen Island, Howe Sound—Coast Ranges and coast region.

An association of grey opaque quartz with small quantities of a yellowish-white serpentine schist, through which was disseminated a little iron-pyrites. Weight of sample, one pound two ounces. Assays showed it to contain:

| | |
|---|---|
| Gold | trace. |
| Silver | 0·116 of an ounce to the ton of 2,000 lbs. |

86.—Also from Bowen Island.

A dark greenish-grey quartzite carrying small quantities of iron-pyrites, copper-pyrites and galena. Weight of sample, thirteen ounces. It contained:

| | |
|---|---|
| Gold | none. |
| Silver | 21·583 ounces to the ton of 2,000 lbs. |

87.—This, and the following specimen, is from Texada Island—Coast Ranges and coast region. They were examined for Mr. A. Raper.

A greenish-yellow quartzite carrying some magnetic-pyrites and a little copper-pyrites. Weight of sample, six ounces. Assays gave:

| | |
|---|---|
| Gold | trace. |
| Silver | 0·816 of an ounce to the ton of 2,000 lbs. |

88.—From the "Guiding Star" claim.

A dark greenish-grey banded quartzite with interstratified white calcite. Weight of sample, eight ounces and a-half. It contained:

| | |
|---|---|
| Gold | trace. |
| Silver | trace. |

## MINERALOGICAL NOTES.

Mineralogical notes.

1.—**Voigtite?** A hydrous biotite very closely allied, if indeed not directly referable to, this species, occurs, with staurolite and garnet, in mica schist, at North-east Harbour, Shelburne county, Nova Scotia. The garnet which is in the form of more or less minute, and for the most part rounded, crystals is disseminated, indifferently, through the staurolite and mica crystals and schist.

Voigtite.

Colour, nearly black—in thin laminæ and by transmitted light, reddish-brown. Lustre of cleavage surface, pearly. Laminæ—inelastic, flexible. Before the blow-pipe, easily fusible to a magnetic globule. Readily decomposed by hydrochloric acid, leaving the silica in colourless scales. A determination of the water—direct estimation—by Mr. Johnston, gave 6·04 per cent.

2.—**Jamesonite.** A fibrous massive form of this mineral has been found on Vermont Creek, as also on Deception Creek (at the "Seyenite Bluff" claim), Middle Fork of the Spilimichene River, East Kootanie, British Columbia. A specimen from the former locality has been examined by Mr. Johnston, and found to contain a trace of gold and 0·02 per cent of silver.

Jamesonite.

3.—**Freibergite.** An argentiferous tetrahedrite, which was found by Mr. Johnston to contain 3·09 per cent of silver, occurs, in quartz, on the branch entering Eagle River from the north-west, near Sicamous, Shuswap Lake, British Columbia.

Freibergite.

4.—**Native Platinum** has been found, in association with gold, on the bars in the North Saskatchewan River, in the neighbourhood of Edmonton, district of Alberta, North-west Territory.

Native platinum.

A sample of the material from this locality, received from Mr. William Pearce, consisted of exceedingly minute rounded and flattened grains of native platinum, the largest not exceeding one-fourth of a millimetre in diameter, with intermixed, equally minute scales of native gold. Mr. Johnston found a certain proportion, about one-fourth, of the platinum to be magnetic. No evidence could be obtained of the presence of iridosmine in the particular sample examined.

5.—**Native Mercury.** Has been met with, *in situ*, in the form of minute globules scattered through a thin seam of cinnabar traversing a greenish felsite, occurring at the eastern entrance to Seshart Channel, Barclay Sound, Vancouver Island, British Columbia. It had previously been observed, according to Dr. G. M. Dawson, in a

Native mercury.

Mineralogical notes—*Con.*

similar form, in some parts of the silver ore of Silver Peak, near Hope, on the Fraser River, in the same province.

Cinnabar.

6.—CINNABAR. This mineral, the localities of occurrence of which, in Canada, were given in a previous report—Ann. Rep. Geol. Surv., Can., vol. ii, p. 9 T, 1886—has more recently been found, *in situ*, traversing a greenish-grey felsite, at the eastern entrance to Seshart Channel, Barclay Sound, Vancouver Island, British Columbia.

Lazulite.

7.—LAZULITE. Amongst the rock specimens collected by the late Mr. James Richardson at the time of his exploration of the Lake Mistassini region, province of Quebec, in 1870, was one which has recently been examined by Mr. R. A. A. Johnston, and found to consist in part of lazulite. The specimen consisting of an intimate association of a bright blue granular lazulite and colourless sub-transparent quartz, constituting bands in a brownish, in parts pale reddish-brown, quartzite.

Metacinnabarite.

8.—METACINNABARITE. The material in question which was sent to the Survey for identification by Mr. W. H. Robertson, came from the "Timothy" claim, west side of Read Island which together with Valdes Islands, from which it is separated by Hoskyn Inlet, lie off the north-east coast of Vancouver Island, British Columbia.

It consisted of a bluish-black (under the lens greyish-black), amorphous, mercuric sulphide, lining or filling cavities and fissures in a light greyish quartz ; the latter being also, in parts, flecked with carmine-red cinnabar. The dark sulphide has a metallic lustre and affords a greyish-black streak. Submitted to a careful qualitative examination by Mr. Johnston, it was found to consist of pure mercuric sulphide. There is no record, so far as I am aware, of this mineral having been hitherto recognized as occurring elsewhere than at the "Readington Quicksilver mine," in Lake county, California, where it is said to constitute the most abundant and valuable ore of the mine.

Sphalerite.

9.—SPHALERITE. A brownish-black, fine to somewhat coarse granular, massive zinc-blende has been met with on the north side (about seven miles inland) of Burrard Inlet, opposite Vancouver, British Columbia. The deposit, which is owned by Messrs. T. Tompkins and H. Abbott, is said, by the former gentleman, to be of considerable extent—such being the case it would be of economic importance inasmuch as blende constitutes one of the principal ores of zinc. A sample of the mineral, which was practically free from gangue, was assayed for gold and silver and with negative results. Mineralogical notes-*Con.*

10.—GRAPHITE. From lot thirty-four, range eight, of the township of Denbigh, Addington county, province of Ontario. Examined for Mr. R. Bowie. Graphite.

A sample of the material from this locality, in which the graphite occurred, for the most part, in the form of layers and patches in a calcareo-siliceous gangue, has been examined by Mr. Johnston, and found to contain 51·67 per cent graphite.

11.—TALC. An almost snow-white talc is found on lot thirty-four of the second range of the township of Clarendon, Frontenac county, Ontario. Examined for Mr. R. Bowie. Talc.

Should the finder's anticipations, as regards the extent of the deposit, be realized, the latter may prove of some economic importance, inasmuch as there is great probability that this material will be found as well adapted for use as a filler in the manufacture of paper, as the talcose mineral found in the town of Edwards, some eleven miles from Gouverneur, St. Lawrence county, in the state of New York.

12.—PYRITE. A crystalline granular, massive, iron-pyrites, through which is disseminated a trifling amount of blende, occurs at the head of Eckstall Inlet, south of Port Essington, Skeena River, British Columbia, where it is said to constitute a vein fifteen feet wide, nearly vertical, running in a north-easterly direction from the shore and traceable for nearly a mile. It has been examined by Mr. Johnston and found to contain a trace of gold and 0·350 of an ounce of silver to the ton of 2,000 lbs., likewise a trace of copper and a little zinc, but no nickel or cobalt. Pyrite.

13.—COOKEITE. ? The material here referred to was collected by Mr. J. J. Driscoll on the Wait-a-bit Creek, which flows into the Columbia River about two miles north of Donald, British Columbia,—where, as this gentleman informs me, it occurs in small quantities, in thin layers in a talcose schist as also in small cavities in the quartz veins which traverse the latter. Cookeite.

The mineral occurs in crystalline foliated translucent masses of a faint greyish-white to white, or silvery-white and pale apple-green colour. In thin folia it is colourless and transparent. Lustre, pearly. Feel, greasy.

Mineralogical notes-*Con.*

Cookeite-*Con.*

It was examined by Mr. Johnston who found that—before the blowpipe it exfoliates like vermiculite and colours the flame intense carmine-red ; in the closed tube gives off water and affords a reaction for fluorine ; it is slightly fusible and gives a blue colour with cobalt solution ; with salt of phosphorus it gives a skeleton of silica. The specimen will be submitted to analysis and its exact composition determined.

The talcose schist above referred to, a hydromica schist, has a foliated structure, a light brownish-grey to light reddish-brown colour and greasy feel. It is made up of minute scales of a hydrous mica disseminated through an earthy admixture of carbonates of lime, magnesia and iron, and ferric hydrate. The hydrous mica, of which it is proposed to make a complete quantitative analysis, contains but trifling amounts of lime and magnesia, but a high percentage of potassa and soda, the latter preponderating. Before the blowpipe fuses on the edges with great difficulty. Affords a faint yet decided reaction for lithium and caesium.

The material of the quartz veins consisted of a white sub-translucent quartz with inclusions of a white, occasionally light reddish, opaque, cleavable calcite, and carrying small quantities of chalcocite, chalcopyrite, a little pyrrhotite and a few crystals of pyrite. It was in parts stained with ferric hydrate and, here and there, with a little blue and green carbonate of copper.

Fibrolite.

14.—Fibrolite. This mineral, as also cyanite, has been met with by Mr. A. E. Barlow (Survey) in a pegmatite vein cutting Laurentian gneiss, on lot nine, range three, of the township of Dryden, district of Nipissing, Ontario. In the specimens examined it formed layers on a garnetiferous gneiss. Structure, fibrous ; traversed, at right angles to the fibres, by numerous fine fissures. Colour (of fresh surfaces), pale bluish-grey to greyish-white.

Mineral associations of apatite.

15.—Mineral Associations of Apatite. The minerals observed and enumerated by Professor B. J. Harrington (Rep. Geol. Surv., Can., 1877-78, part G) as occurring in the apatite deposits of Ottawa county, province of Quebec, included :

Albite, calcite, chabazite, chalcopyrite, chlorite, epidote, fluorite, galena, garnet, graphite, hematite, hornblende, idocrase, molybdenite, orthoclase, phlogopite, prehnite, pyrite, pyroxene, pyrrhotite, quartz, rutile, scapolite, sphalerite, talc (steatite) ?, titanite, tourmaline, Wilsonite and zircon.

Since then, there has been added to the mineralogical collection in the Museum of this Survey—(1) An association of mag-

Mineralogical notes—Con.

Mineral associations of apatite—Con.

netite, apatite and orthoclase, from the township of Huntley, Carleton county, Ontario, collected by Mr. C. W. Willimott; (2) an association of stilbite, chabazite and pyroxene; (3) of stilbite, apatite, pyroxene and phlogopite, and (4) of stilbite, apatite and scapolite, from McLaren's apatite mine, township of Portland East, Ottawa county, province of Quebec, collected by Mr. J. F. Torrance; also (5) an association of Heulandite and chabazite with a little pyrite, found by Mr. Willimott, lining a cavity in pyroxene at the Emerald apatite mine, in the township of Buckingham, also in Ottawa county. Of these, magnetite has already been referred to, by Dr. Harrington, as occurring in apatite-bearing veins in Ontario, and the occurrence of stilbite has been noted by Mr. Torrance; Heulandite, however, has not previously been recognized as occurring in these deposits.

Mineral inclusions in mica

16.—Mineral Inclusions in Mica. Of such occurrences there has recently been presented to the Museum of this Survey (1) a plate of phlogopite in which is embedded, parallel to the cleavage planes of the mica, a sharply defined hexagonal plate of molybdenite measuring twelve millimetres across—from the township of Hull, Ottawa county, province of Quebec; (2) a plate of phlogopite between the cleavage planes of which occur some highly distorted octahedra of pyrite, also from the township of Hull; (3) a plate of phlogopite, measuring eight centimetres across, upon the face of which, and almost but not quite covering the same, there occurs a thin layer of pale apple-green, fine fibrous, radiated (arborescent-like) actinolite; (4) a plate of phlogopite having an inclusion of albite, and intimately associated with this, crystals of apatite, pyrite and garnet; and (5) an inclusion of purple fluorite with pyroxene in phlogopite—all from the same township as the preceding. There were previously in the Museum—(6) a plate of phlogopite with inclusions of light blue crystalline calcite—from the township of Wakefield; (7) sheets of muscovite in which are embedded, distorted and more or less flattened, in the direction of the cleavage planes of the mica, crystals of spessartite—from the township of Villeneuve; (8) a section of a crystal of phlogopite in which there occurs a small prism of the same mineral, the vertical axis of which is parallel to the cleavage planes of the inclosing mica—from the township of Templeton, which, together with the two last named townships, is in the county of Ottawa, province of Quebec; (9) a plate of phlogopite in which is embedded, parallel to the cleavage planes of the mica, a prism of apatite thirty-six millimetres in length—from the township of

Mineralogical notes—*Con.*

North Burgess, Lanark county, Ontario; and (10) a specimen of muscovite with lenticular shaped, in the direction of the cleavage planes of the mica, inclusions of white sub-transparent quartz, from Yeo's Island, in the Upper St. Maurice, Portneuf county, province of Quebec.

Miscellaneous examinations.

## MISCELLANEOUS EXAMINATIONS.

Semi-anthracite from Main Red Deer River, British Columbia.

1.—SEMI-ANTHRACITE. From the Main Red Deer River, in or near the base of the Rocky Mountains—about one hundred miles north of Anthracite, British Columbia. Examined for Mr. P. McCarthy.

A proximate analysis, by fast coking, gave:

| | |
|---|---|
| Volatile matter | 13·98 |
| Fixed carbon | 81·94 |
| Ash | 4·08 |
| | 100·00 |

Coke, non-coherent. Colour of ash, white.

This fuel has very nearly the same composition as the semi-anthracite from Bow River, right bank, about a mile and a-half from Canmore station—of which an analysis (No. 50) is given in Annual Report, Geol. Surv., Can., 1885, p. 10 M.

Phosphatic rock from Macintosh Brook, Cape Bretoncounty, Nova Scotia.

2.—PHOSPHATIC ROCK. From the mouth of Macintosh Brook, on the shore below Allan and Donald McAdam's, north shore East Bay, Cape Breton county, Nova Scotia. Collected by Mr. T. C. Weston (Survey).

The mode of occurrence of this rock, as also the results of a microscopic examination of the same by Mr. T. C. Weston, is referred to by Mr. H. Fletcher in the Report of Progress Geol. Surv., Can., for 1876-77, p. 432. It is stated to be, for the most part, composed of fragments of Lingula with some phosphatic nodules. Agreeably with the results of determinations made by Mr. R. A. A. Johnston, it contains 0·56 per cent of phosphoric acid, which corresponds to 1·22 per cent of tribasic phosphate of lime.

Quartz sand from Coal River, lower Missinaibi River, Ontario.

3.—QUARTZ SAND. A sand composed of grains of white translucent quartz with a few intermixed grains of unaltered, or partially weathered, felspar, was met with, by Mr. E. B. Borron, in the course of boring in the post-tertiary deposits at the mouth of Coal River, lower Missinaibi River, about eighty miles above Moose Factory, province of Ontario.

Miscellaneous examinations—*Con.*

.—Volcanic Tufa. From Lawn Hill, near the entrance to Skidegate Inlet, Queen Charlotte Island, British Columbia. Geological position, Tertiary. Collected by Dr. G. M. Dawson (Survey).

Volcanic tufa from Lawn Hill, Skidegate Inlet, British Columbia.

This material, of which there is a considerable deposit at the above mentioned locality, very closely resembles in appearance the trass of the Rhine valley, so much so indeed as to lead to the inference that it might not improbably be found to possess, when combined with a rich lime, the same hydraulic properties. Desirous of ascertaining how far this conjecture is borne out by fact, I have experimented with this material in the manner, and with the results, here stated.

The tufa was very finely pulverized, without previous calcination—the other ingredients consisted of a very fine, sharp and angular siliceous sand, and a fat lime slaked to a dry powder with water. The ingredients were mixed, on one occasion by weight, and on the other by volume. The resultant mixture was made into a stiff paste with water and fashioned, in a mould, into circular cakes having a diameter of one inch and a-half and a thickness of one inch. These were immersed in water as soon as made.

In the first series of experiments, lime was the only addition made and the ingredients were mixed by weight, employing respectively one-half, one and two parts of lime to one of tufa. After an immersion of seven days the first of these mixtures had acquired a little firmness, the two latter, however, still retained much of their original plasticity. A further immersion, extending over three weeks, was attended with but slightly better results. The one containing the smallest proportion of lime, although somewhat firmer, readily yielded to pressure between the fingers, whilst the other two, which evidently contained far too large a proportion of lime, were quite tender.

In the second series of experiments, the additions consisted of lime, and lime in conjunction with sand, and the ingredients were mixed by measure. The ratios employed being—half a volume of lime to one volume of tufa (which, with the particular lime employed, equalled a very little over one-third part, by weight, of lime to one part, by weight, of tufa), and one volume of lime and one volume of sand to one volume of tufa. The immersion in water extended over six weeks. A slight consolidation was perceptible after the seventh day, and this became gradually more and more pronounced, but even after four weeks' immersion, the

Miscellaneous examinations-*Con.*

various cakes could still be pierced with a sharp steel point and yielded to pressure between the fingers, and it was not until after the sixth week that they exhibited a tendency to withstand these tests and then not in a perfectly satisfactory manner.

Volcanic tufa from Lawn Hill, Skidegate Inlet, British Columbia-*Con.*

Pozzuolana and trass when finely pulverized, without previous calcination, and mixed, in the same proportions as were used by me in the second series of experiments, with lime or lime and sand, form mortars which harden under water, those of the former in from three to four days, and those of the latter in from four to five days.

The results of the experiments tend to show that this material, in the crude state, in combination with a rich lime, manifests such slight hydraulic activity or power that it would be, thus used, unsuited for the manufacture of a cement intended for constructions under water or in positions subjected to immediate submersions.

GEOLOGICAL SURVEY DEPARTMENT.
ALFRED R. C. SELWYN, C.M.G., LL.D., F.R.S., DIRECTOR.

DIVISION OF

# MINERAL STATISTICS AND MINES

## ANNUAL REPORT

FOR

## 1890.

ELFRIC DREW INGALL.
*Associate of the Royal School of Mines, England,*
*Mining Engineer to the Geological Survey of Canada.*
IN CHARGE.

H. P. BRUMELL
*Assistant to the Division.*

PUBLISHED BY AUTHORITY OF PARLIAMENT

OTTAWA:
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EXCELLENT MAJESTY.
1891.

# NOTE

Except for the figures of imports, which refer to the fiscal year, beginning 1st July, the year used throughout this report is the calendar year, and the ton, that of 2,000 pounds, unless otherwise stated.

The figures given throughout the report referring to exports and imports are compiled from data obtained from the books of the Customs Department, and will occasionally show discrepancies, which, however, there are no means of correcting.

The exports and imports, under the heading of each province, do not necessarily represent the production and consumption of the province *e. g.*, material produced in Ontario is often shipped from Montreal and entered there for export, so falling under the heading, Quebec.

The values of the metallic minerals produced, as per returns to this Department, are calculated on the basis of their metallic contents at the average market price of the metal for 1890. Spot values have been adopted for the figures of production of the non-metallic minerals.

N.E.S.=Not elsewhere specified.

## ERRATUM.

Page 3, 2nd line from bottom, for "Exports and Imports," *read* Imports.

ALFRED R. C. SELWYN, C. M. G., F. R. S., &c.,
*Director and Deputy Head,*
*Geological Survey Department of Canada.*

SIR,—I beg herewith to hand you the annual report of the Division Mineral Statistics and Mines for the year 1890.

Difficulty continues to be experienced in securing the information omptly enough to issue the report earlier, although, as formerly, a eliminary summary statement of the mineral production of the country is issued early in April. In this, the quantities of which no returns d been received, were estimated as nearly as possible. These have en revised since the complete returns became available.

## ERRATUM.

P. 141 S, line 9 from top.—*After* Where no allowance is made y the buyers *insert* for the copper.

eretofore.

The plan of reproducing suitable matter from the reports of the rovincial mining bureaus has been adopted. This information has en incorporated with our own material, and will thus receive a wider rculation and will tend to make the report a more complete review of e progress of mining and allied industries in the Dominion.

To facilitate the work of compilation the fiscal year has been lopted, instead of the calendar year as heretofore, for the figures of ports and imports. Greater uniformity has been attained by stating e values of the metallic products in terms of the metals contained in the ores, etc., at the average market price of each for the year, thus following the usual practice as well for these as for the non-metallic products, which, as formerly, are given at their spot value.

Apart from the compilation of the annual report the other functions of the division have been performed, as far as the present means at command would permit.

Numerous enquiries have been received and answered, respecting the mining and mineral resources of the country, often involving considerable research to give the details asked for.

The Directory of Mineral Occurrences has also received further attention, and is now almost complete. The system of signs already used by the Survey for representing mineral occurrences on the maps has been elaborated and extended, so that the distribution of the mineral resources of the country can be shown graphically, and thus afford information on this important subject in a concise form.

The arrangements made with the British Columbia Government,* whereby the aid of their local commissioners has been secured, should insure prompt receipt of information relating to mineral discovery and mining progress in the different districts of that province. It is hoped that it may be found possible to complete arrangements already partly made covering other portions of the Dominion. These would include a correspondent in each mining centre, thus attaining the same result as in British Columbia. Corroborative investigation by an officer of this bureau, where required, would then afford full and reliable information.

In conclusion it is desired to gratefully acknowledge the aid received from various sources. Thanks are due to all—a number too numerous to mention here—who, by answering our circulars or letters, have provided much valuable material for the compilation of the report.

Special mention must again be made of the services rendered by my colleague, Mr. H. P. Brumell, assistant to the Division, for his very important and efficient aid in every branch of the work. Apart from his duties in the compilation of the figures he has been a large contributor to the report; the following articles being specially due to him, viz.:—Abrasive Materials, Petroleum, Natural Gas, Mineral Pigments, Sa Structural Materials, Gypsum and Manganese.

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*Summary Report Geological Survey Department, 1890, p. 11.

Our acknowledgments are also due to the Provincial Departments of Mines of Nova Scotia and British Columbia, and to the Dominion Customs Department for aid received.

I have the honour to be, Sir,
Your obedient servant,
ELFRIC DREW INGALL.

Division of Mineral Statistics and Mines,
July 10th, 1891.

## SUMMARY OF THE MINERAL PRODUCTION OF CANADA IN 1889 AND 1890.

| PRODUCT. | | 1889. | | 1890. | |
|---|---|---|---|---|---|
| | | Quantity. | Value. | Quantity. | Value. |
| *Metallic.* | | | | | |
| Copper (fine, contained in ore) | Lbs. | 6,809,752 | $ 885,424 | 6,013,671 | $ 902,050 |
| Gold | Ozs. | 72,328 | 1,295,159 | 64,046 | 1.149,776 |
| Iron ore | Tons. | 84,181 | 151,640 | 76,511 | 155,380 |
| do pig | " | .......... | (b) | .......... | (b) |
| Lead (fine, contained in ore, &c.) | Lbs. | 165,100 | 6,604 | 113,000 | 5,085 |
| Nickel (fine, contained in ore, &c.) | " | (a) | (a) | 1,435,742 | 933,232 |
| Platinum | Ozs. | 1,000 | 3,500 | .......... | 4,500 |
| Silver (fine, contained in ore, &c.) | " | 383,318 | 343,848 | 400,687 | 420,662 |
| Total, Metallic | | .......... | 2,686,175 | .......... | 3,570,685 |
| *Non-metallic.* | | | | | |
| Antimony ore | Tons. | 55 | 1,100 | 26½ | 625 |
| Arsenic | " | .......... | .......... | 25 | 1,500 |
| Asbestus | " | 6,113 | 426,554 | 9,860 | 1,260,240 |
| Coal | " | 2,719,478 | 5,584,182 | 3,117,661 | 6,496,110 |
| Coke | " | 54,539 | 155,043 | 56,450 | 164,298 |
| Felspar | " | .......... | .......... | 700 | 3,500 |
| Fertilizers | " | 775 | 26,606 | 1,203 | 31,889 |
| Fire-clay | " | 400 | 4,800 | .......... | .......... |
| Glass and glassware | | .......... | 150,000 | .......... | 537,130 |
| Graphite | Tons. | 242 | 3,160 | 175 | 5,200 |
| Grindstones | " | 3,404 | 30,863 | 4,884 | 42,340 |
| Gypsum | " | 213,273 | 205,108 | 226,509 | 194,033 |
| Limestone for flux | " | 22,122 | 21,909 | 18,478 | 18,361 |
| Manganese ore | " | 1,455 | 32,737 | 1,328 | 32,550 |
| Mica | Lbs. | 36,529 | 28,718 | 770,959 | 68,074 |
| Mineral pigments— | | | | | |
| Baryta | Tons. | 794 | 15,280 | 1,842 | 7,543 |
| Ochres | " | | | 275 | 5,125 |
| Mineral water | Galls. | 424,600 | 37,360 | 561,165 | 66,031 |
| Moulding sand | Tons. | 170 | 850 | 320 | 1,410 |
| Petroleum | Brls. | 639,991 | 612,101 | 765,029 | 902,734 |
| Phosphate | Tons. | 30,988 | 316,662 | 31,753 | 361,045 |
| Precious stones | | .......... | .......... | .......... | 700 |
| Pyrites | Tons. | 72,225 | 307,292 | 49,227 | 123,068 |
| Quartz | " | .......... | .......... | 200 | 1,000 |
| Salt | " | 32,832 | 129,547 | 43,754 | 198,897 |
| Soapstone | " | 195 | 1,170 | 917 | 1,239 |
| Structural materials and clay products— | | | | | |
| *Bricks | M | 200,561 | 1,273,884 | 211,727 | 1,266,982 |
| *Building stone | C. yds. | 341,337 | 913,691 | 382,563 | 964,783 |
| Cement | Brls. | 90,474 | 69,790 | 102,216 | 92,405 |
| Flagstones | Sq. ft. | 14,000 | 1,400 | 17,865 | 1,643 |
| Granite | Tons. | 10,197 | 79,624 | 13,307 | 65,985 |
| *Lime | Bush. | 2,948,249 | 362,848 | 2,501,079 | 412,308 |
| Marble | Tons. | 980 | 980 | 780 | 10,776 |
| Miscellaneous clay prod'ts | | .......... | 239,385 | .......... | .......... |
| Pottery | | .......... | .......... | .......... | 195,242 |
| Carried forward | | .......... | 11,032,644 | .......... | 13,536,766 |

## UMMARY OF THE MINERAL PRODUCTION OF CANADA IN 1889 AND 1890—*Concluded.*

| PRODUCT. | 1889. | | 1890. | |
|---|---|---|---|---|
| | Quantity. | Value. | Quantity. | Value. |
| Brought forward | | $11,032,644 | | $13,536,766 |
| *Non-metallic*—Concluded. | | | | |
| Roofing cement.......... Tons. | | | 1,171 | 6,502 |
| Sand and gravels (exports) " | 283,044 | 52,647 | 342,158 | 65,518 |
| Sewer pipes | | | | 348,000 |
| Slate.......... Tons. | 6,935 | 119,160 | 6,368 | 100,250 |
| Terra-cotta | | | | 90,000 |
| *Tiles .............. M | 10,526 | 134,265 | 10,521 | 140,877 |
| Sulphuric acid .............. Lbs. | 10,998,713 | 152,592 | 11,118,779 | 145,235 |
| Whiting.............. Brls. | | | 500 | 500 |
| Total Non-metallic | | $ 11,491,308 | | $ 14,433,648 |
| do Metallic | | 2,686,175 | | 3,570,685 |
| Estimated value of mineral products not returned (principally structural material) | | 992,838 | | 995,667 |
| Total | | $ 15,170,321 | | $ 19,000,000 |
| Items left out, 1890—Iron, steel, charcoal and pig iron | | (*b*) 4,329,679 | | |

---

* Incomplete.

(*a*) Owing to the returns of nickel for 1889 being confidential the value had to be inclued in the last item of the table, viz., estimated values.

(*b*) Statistics of the production of iron, steel and charcoal were not collected for 1890. The pig iron produced was all included under the head of iron ore.

### EXPORTS.

### INERAL AND MINERAL PRODUCTS, MINED OR MANUFACTURED IN CANADA, DURING 1890.

| PRODUCT. | VALUE. | PRODUCT. | VALUE. |
|---|---|---|---|
| Acid, sulphuric | $ 4,393 | Mica, crude and cut | $ 19,171 |
| Asbestus, first-class | 453,704 | do ground | 3,297 |
| do second-class | 58,973 | Nickel | 89,568 |
| do third-class | 15,853 | Oil, crude and refined | 18,154 |
| Barytes | 1,960 | Ore, antimony | 1,000 |
| Brick | 3,762 | do iron | 40,690 |
| Coal | 2,436,906 | do manganese | 36,831 |
| oke | 21 | do silver | 204,142 |
| opper | 398,497 | Phosphate | 499,369 |
| ertilizers | 5,778 | Plumbago | 1,529 |
| old | 706,792 | Salt | 1,667 |
| lass and glassware | 12,015 | Sand and gravel | 65,518 |
| rindstones | 18,564 | Slate | 153 |
| ypsum, crude | 192,254 | Stone, unwrought | 43,611 |
| do ground | 105 | do wrought | 21,725 |
| ron and steel.......about | 275,000 | Other articles | 7,735 |
| ime and cement | 168,804 | | |
| | | Total | 5,807,541 |

## EXPORTS.

### PRODUCTS OF THE MINE DURING THE FISCAL YEAR, 1890.

| EXPORTED TO | VALUE. | EXPORTED TO | VALUE. |
|---|---|---|---|
| United States | $ 3,963,257 | Brazil | $ 2,205 |
| Great Britain | 630,815 | France | 1,132 |
| Newfoundland | 167,075 | Belgium | 900 |
| St. Pierre | 19,905 | Spain | 500 |
| Germany | 17,067 | Danish West Indies | 300 |
| British West Indies | 12,170 | Norway and Sweden | 197 |
| Spanish do | 11,994 | | |
| Sandwich Islands | 10,312 | Total | 4,855,757 |
| Hong Kong | 7,254 | | |
| Japan | 7,200 | 1889 | 4,419,170 |
| British Guiana | 3,474 | | |
| | | 1888 | 4,110,937 |

## IMPORTS.

### MINERALS AND MINERAL PRODUCTS, FISCAL YEAR, 1890.

| PRODUCT. | VALUE. | PRODUCT. | VALUE. |
|---|---|---|---|
| Alum and aluminous cake | $ 28,758 | Grindstones | $ 20,569 |
| Antimony | 17,439 | Gypsum | 4,064 |
| Arsenic | 4,474 | Iron and steel | 8,473,741 |
| Asbestus and manufactures | 13,250 | Lead and manufactures of | 368,180 |
| Ashes, pot, pearl and soda | 2,138 | Lime | 5,360 |
| Asphaltum | 68,454 | Litharge | 31,401 |
| Baryta | 978 | Lithographic stone | 4,071 |
| Borax | 24,845 | Manganese oxide | 3,192 |
| Brass and manufactures of | 554,545 | Marble | 99,353 |
| Bricks | 12,500 | Mercury | 7,677 |
| do bath | 2,225 | Mineral water | 40,802 |
| do and tiles, fire | 96,537 | Nickel | 75 |
| Buhrstone | 2,506 | Ochres | 14,066 |
| Building stone | 132,155 | Paraffine wax | 15,844 |
| Cement | 14,491 | Petroleum and manufactures of | 515,852 |
| do Portland | 313,572 | Plaster of Paris | 6,008 |
| Chalk | 7,221 | Platinum | 5,215 |
| Clays— | | Potash salts | 10,787 |
| China | 28,167 | Precious stones | 119,824 |
| Fire | 21,366 | Salt | 309,840 |
| All other, N.E.S | 11,044 | Sand and gravel | 36,768 |
| Coal, anthracite | 4,595,727 | Silex | 2,617 |
| do bituminous | 3,528,959 | Slate | 22,871 |
| do dust, &c | 29,818 | Soda salts | 327,961 |
| do tar and pitch | 19,345 | Stone or granite, N.E.S | 84,396 |
| Coke | 133,344 | Spelter | 71,122 |
| Copper and manufactures of | 484,189 | Sulphur | 44,276 |
| Copperas | 4,001 | Sulphuric acid | 2,927 |
| Earthenware | 695,206 | Tiles, sewer pipes, &c | 77,434 |
| Emery and pumice | 19,925 | Tin and manufactures of | 1,289,756 |
| Fertilizers | 46,637 | Whiting | 27,471 |
| Flagstones | 48,995 | Yellow metal | 98,472 |
| Fullers' earth | 1,060 | Zinc and manufactures of | 99,002 |
| Glass and glassware | 1,230,585 | | |
| Graphite and manufactures of | 36,881 | Total | 24,472,327 |

## ABRASIVE MATERIALS.

Notwithstanding the many extensive deposits of tripoli, buhrstone, and rocks suitable for the manufacture of whetstones, nothing has been done during the past year in the production of abrasive materials beyond the manufacture of grindstones and a small quantity of scythe-stones at several of the grindstone quarries.

New Brunswick.

*Tripoli.*—This material which occurs in the Dominion, generally in lake bottoms, is found in great quantity in New Brunswick and Nova Scotia. In the former province the localities best known are Pollet-River Lake, Mechanic's Settlement and Fitzgerald Lake, in King's Co., and Pleasant Lake, St. John Co.

Of the material from the former locality, an analysis was made in 1879 by Mr. G. C. Hoffmann, Chemist to the Survey, with the following result:—

| | |
|---|---|
| Silica | 80·487 |
| Alumina | 3·146 |
| Ferric oxide | 0·951 |
| Lime | 0·342 |
| Magnesia | 0·283 |
| Carbonic acid | 0·011 |
| Phosphoric acid | ? |
| Potash and soda | ? |
| Water combined and hygroscopic and organic matter | 13·321 |
| | 98·541 |

In the lakes above-mentioned the material is said to be in very considerable quantity, the deposit at Fitzgerald Lake being, throughout the area of the lake, over 10 feet in thickness.

Small quantities have at various times been shipped from these deposits, though in no instance has the shipment exceeded a few tons for experimental purposes. None was shipped from this province during 1890.

Nova Scotia.

In Nova Scotia, the list of lakes already known to afford tripoli is too great to publish here, being scattered over Pictou, Colchester, Cumberland, King's, Halifax, Victoria and Cape Breton counties. Little work has been performed, though, it is believed, small lots of a few tons have been shipped. None was raised during 1890.

The following table shows the imports of material classified by the Customs Department as "silex," presumably tripoli, or manufactures of the same:—

ABRASIVE MATERIALS.

TABLE 1.

IMPORTS OF "SILEX."

| Fiscal Year. | Cwts. | Value. |
|---|---|---|
| 1880 | 5,252 | $2,290 |
| 1881 | 3,251 | 1,659 |
| 1882 | 3,283 | 1,678 |
| 1883 | 3,543 | 2,058 |
| 1884 | 3,259 | 1,709 |
| 1885 | 3,527 | 1,443 |
| 1886 | 2,520 | 1,313 |
| 1887 | 14,533 | 5,073 |
| 1888 | 4,808 | 2,385 |
| 1889 | 5,130 | 1,211 |
| 1890 | 1,768 | 2,617 |

*Pumice Stone.*—This material has not as yet been found in Canada. The imports will be found included with those of Emery in table 2.

*Emery.*—Corundum has not as yet been found in any quantity in Canada, thus making it impossible that there should be any production of emery. The Dominion, however, contains very extensive garnet deposits, which may at any time be worked and produce large quantities of a material which is to a certain extent used as a substitute for emery, though having a less degree of hardness.

The imports of emery, in addition to pumice stone are given in the following table:—

ABRASIVE MATERIALS.

TABLE 2.

IMPORTS OF PUMICE STONE AND EMERY.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $7,854 |
| 1881 | 11,179 |
| 1882 | 15,762 |
| 1883 | 17,823 |
| 1884 | 16,518 |
| 1885 | 14,450 |
| 1886 | 14,458 |
| 1887 | 15,617 |
| 1888 | 18,564 |
| 1889 | 16,888 |
| 1890 | 19,925 |

As the value of emery wheels is not altogether dependent on the quantity of contained emery, it has been thought better not to include the imports of this manufacture in the preceding table.

*Buhrstones.*—In the descriptive catalogue of a collection of minerals sent to Philadelphia in 1876, the following description of an area of rocks suitable for buhrstones is given:—

"This buhrstone constitutes a series of veins, cutting an intrusive mass of syenite, which occupies an area of thirty-six square miles, among the Laurentian rocks of Grenville, Chatham and Wentworth. The veins consist of yellowish-brown or flesh-red cellular chert; the colours, in some cases, running in bands parallel to one another and sometimes being rather confusedly mingled, giving the aspect of a breccia. The cells are unequally distributed, some parts being nearly destitute of them, while in others they are very abundant, and of various sizes, from that of a pin's head to an inch in diameter."

This deposit for other than the purpose of obtaining specimens has not yet been opened, nor have any buhrstones been as yet made from Canadian material. The imports are given in the following table:—

ABRASIVE MATERIALS.

TABLE 3.

IMPORTS OF BUHRSTONES.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $12,049 |
| 1881 | 6,337 |
| 1882 | 15,143 |
| 1883 | 13,242 |
| 1884 | 5,365 |
| 1885 | 4,517 |
| 1886 | 4,062 |
| 1887 | 3,545 |
| 1888 | 4,753 |
| 1889 | 5,465 |
| 1890 | 2,506 |

*Grindstones.*—Throughout the area covered by the Carboniferous and Permian rocks in Eastern New Brunswick and Nova Scotia are extensive areas of sandstone, eminently suitable for the manufacture of grindstones. The industry is carried on in the district surrounding Shepody and Cumberland Bay, at the North-East end of the Bay of Fundy; at Newcastle, Northumberland county; and along the south shore of the Baie des Chaleurs from Janeville to Grand Anse, in Gloucester county, New Brunswick; and throughout Pictou and Cumberland counties, Nova Scotia.

Although there are a considerable number of operators, the production is but small, as outside of the Baie des Chaleurs quarries the output is in small quantities from building stone quarries.

Probably the best stone for the manufacture of grindstones is that on the south side of the Baie des Chaleurs, where the industry has been carried on since 1830, and possibly before.

The stone from this district is obtained from beds averaging about six feet in thickness, interstratified with heavy deposits of blue and red shale, pyro-schists and fire clay.

The exposure on the coast at Clifton shows the following section:—

Clay (surface), 10′.
Blue shale, 25′.
Sandstone, 8′ (used in the manufacture of grindstones).
Bituminous shale, 8′.
Fire clay, 6′.
Shale, red (in base of quarry).

Dip very slight, to south-east; strike, north-east.

This section will be approximately repeated along the coast (both east and west), the various beds of sandstone being almost invariably between the blue and the bituminous shales.

The thickness of the beds enables very large stones to be obtained from this district; shipments of stones weighing up to 3 tons being frequently made. The largest stone shipped weighed 7,840 lbs.

As a rule the stone is shipped from Northern New Brunswick in the finished condition, small quantities only of rough hewn ("scabbled") stone being sent away, whereas from Nova Scotia the greater quantity is sent to Boston and other points in the Eastern States in the latter condition to be further manufactured.

The production in New Brunswick during 1890 was, according to returns received at this office, 4,034 tons, valued at $33,804.

For Nova Scotia no returns of production were received. Assuming, however, that the quantity exported was equivalent to that produced, there is for that province a production of 850 tons, valued at $8,536, making a total production of 4,884 tons, valued at $42,340. No grindstones are produced outside of these two provinces.

These figures show a very material increase over those for the year previous, the increase being 1,480 tons, valued at $11,477. The amounts produced during the previous four years were:—

| | | | |
|---|---|---|---|
| 1886 | 4,000 tons, | valued at | $46,545 |
| 1887 | 5,292 " | " | 64,008 |
| 1888 | 5,764 " | " | 51,129 |
| 1889 | 3,404 " | " | 30,863 |

A considerable proportion of the production of Canadian grindstones finds a market in Boston, where they are sold at an average price of $25 per ton, and enter into direct competition with the Ohio stones, which sell at from $10 to $12 per ton.

The exports by provinces for the last hree years are shown in table 4, while in table 5 are shown the total exports since 1884.

ABRASIVE MATERIALS.

TABLE 4.

EXPORTS OF GRINDSTONES.

| Provinces. | 1888. | 1889. | 1890. |
|---|---|---|---|
| Ontario | $ 252 | ........ | ........ |
| Quebec | ........ | $ 1,387 | $ 12 |
| Nova Scotia | 11,430 | 7,150 | 8,536 |
| New Brunswick | 16,494 | 21,437 | 10,016 |
| Manitoba | ........ | 8 | ........ |
| Totals | $28,176 | $29,982 | $18,564 |

ABRASIVE MATERIALS.

TABLE 5.

EXPORTS OF GRINDSTONES.

| Year. | Value. |
|---|---|
| 1884 | $28,186 |
| 1885 | 22,606 |
| 1886 | 24,185 |
| 1887 | 28,769 |
| 1888 | 28,176 |
| 1889 | 29,982 |
| 1890 | 18,564 |

The imports for the past eleven years are given in the following table which explains itself:—

ABRASIVE MATERIALS.

TABLE 6.

IMPORTS OF GRINDSTONES.

| Fiscal Year. | Tons. | Value. |
|---|---|---|
| 1880 | 1,044 | $11,714 |
| 1881 | 1,359 | 16,895 |
| 1882 | 2,098 | 30,654 |
| 1883 | 2,108 | 31,456 |
| 1884 | 2,074 | 30,471 |
| 1885 | 1,148 | 16,065 |
| 1886 | 964 | 12,803 |
| 1887 | 1,309 | 14,815 |
| 1888 | 1,721 | 18,263 |
| 1889 | 2,116 | 25,564 |
| 1890 | 1,567 | 20,569 |

*Hone and Whetstones.*—A small quantity of scythe stones is made at Clifton and Stonehaven, Northumberland Co., New Brunswick, the value of which is included in that given for grindstones. No hone or whetstones (so-called) were produced during the year, nor has there been any production for several years.

## FOSSIL RESIN ("AMBER").

A discovery of considerable importance was reported upon by Mr. J. B. Tyrrell, who, during his summer's work in Northwestern Manitoba, visited an extensive deposit of so-called amber on the west shore of Cedar Lake. This lake is on the Saskatchewan River, of which it is in reality a part, and near its mouth where it empties into Lake Winnipeg, and is distant from the city of Winnipeg about 300 miles.

Mr. Tyrrell in his summary report to the Director of the Survey writes as follows:—

"It occurs mixed with sand and many fragments of partly decayed wood, on a low beach behind a gradually shelving shore and along the face of a deep, wet, spruce swamp. The pieces were for the most part smaller than a pea, but could be readily seen glittering among the sand and vegetable débris. Some pieces were found as large as a robin's egg, and Mr. King informed me that he had collected pieces very much larger. It has evidently been washed up on the shore by the waves, but its exact age has not yet been positively determined.

"The first place at which it was seen was in a small bay behind a limestone point projecting towards the north, but the most extensive posit is more than a mile south of this point, where a rounded beach etches across the margin of a low swamp. This beach is about a mile length, and from eighty to one hundred and twenty feet in breadth. ie "amber" is found most plentifully along its ridge, where it constitutes tween five and ten per cent. by volume of the sand and vegetable bris, and holes dug to a depth of two feet show no diminution in its iantity. Towards the edge of the lake, however, the sand is freer, ith from fragments of wood and "amber." It is difficult to make i accurate estimate of the quantity of "amber" on this mile of beach, it it may confidently be said to be found throughout the distance in band thirty feet wide, with a minimum depth of two feet. This ind has thus a total bulk of 316,800 cubic feet. A number of specimens collected from various parts of it showed an average of a little over n per cent. of "amber," which, in natural fragments, weighed forty-x pounds to the cubic foot. The amount of "amber" on this strip of ach would, therefore, be about 31,680 cubic feet, or 1,457,280 pounds. t a minimum value of 25 cents a pound, this would represent a total of 64,320. This estimate refers merely to the material that is now washed on the ridge of the beach, without considering the source from which is originally derived."

In Canada* "amber" has been found frequently in the coals and gnites of the North-West, and also occurs at many points in the United ates, notably in the Cretaceous and Tertiary beds of New Jersey and assachusetts. These deposits, however, have not as yet been operated mmercially, specimens only having been extracted.

No statistics regarding the market for this substance in Canada are ailable.

The following table of imports into the United States up to 1885† will rove of interest as illustrating a possible outside market for this substance:

| Fiscal Years. | Value. |
|---|---|
| 1869 | $ 427 |
| 1870 | 1,433 |
| 1871 | 180 |
| 1872 | 2,426 |
| 1873 | 1,534 |
| 1874 | 1,448 |
| 1875 | 7,169 |
| 1876 | 15,502 |
| 1877 | 17,307 |
| 1878 | 13,215 |
| 1879 | 17,821 |
| 1880 | 36,860 |
| 1881 | 42,400 |
| 1882 | 72,479 |
| 1883 | 40,166 |
| 1884 | 56,301 |
| 1885 | 21,722 |

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* Annual Reports Geological Survey of Canada for the following years:—1873-74, 5; 1876-77, pp. 471-3; vol. IV, p. 46T.

† Bulletins U.S. Geological Survey:—Mineral Resources of the United States, by id T. Day, 1886, p. 605.

## ANTIMONY.

The only producing antimony deposit in Canada during the past year was that at Rawdon Mines, Hants county, Nova Scotia, though it cannot be said that the mine was actually in operation, as the shipments consisted of material cobbed from the dumps and consigned to Liverpool, England.

Extensive deposits occur in New Brunswick, at Prince William, and at South Ham, Quebec, neither of which properties have, however, been operated for several years.

The production during the past year amounted to 26½ tons, valued at $625, a decrease since the previous year of 28½ tons and $475.

The annual production for the past four years is:—

| | | | |
|---|---|---|---|
| 1887 | 584 tons, | valued at | $10,860 |
| 1888 | 345 | do | 3,696 |
| 1889 | 55 | do | 1,100 |
| 1890 | 26½ | do | 625 |

Lessened demand by the American companies taking the output of these mines is said to be the cause of the annual decrease in production shown above.

The exports of antimony ore for the past eleven years are as given below:

ANTIMONY.

TABLE 1.

EXPORTS.

| YEAR. | Tons. | Value. | YEAR. | Tons. | Value. |
|---|---|---|---|---|---|
| 1880 | 40 | $ 1,948 | 1886 | 665 | $ 31,490 |
| 1881 | 34 | 3,308 | 1887 | 229 | 9,720 |
| 1882 | 323 | 11,673 | 1888 | 352½ | 6,894 |
| 1883 | 165 | 4,200 | 1889 | 30 | 695 |
| 1884 | 483 | 17,875 | 1890 | 38 | 1,000 |
| 1885 | 758 | 36,250 | | | |

The imports of antimony (other than ore, which is not imported) for the corresponding number of years are as follows :—

ANTIMONY.

TABLE 2.

IMPORTS.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880 | 42,247 | $ 5,903 |
| 1881 | ........ | 7,060 |
| 1882 | 183,597 | 15,044 |
| 1883 | 105,346 | 10,355 |
| 1884 | 445,600 | 15,564 |
| 1885 | 82,012 | 8,182 |
| 1886 | 89,787 | 6,951 |
| 1887 | 87,827 | 7,122 |
| 1888 | 120,125 | 12,242 |
| 1889 | 119,034 | 11,206 |
| 1890 | 117,066 | 17,439 |

## ARSENIC.

The production of arsenic for 1890 has been small. It is all from Deloro, Ontario, and was obtained by resublimating the crude arsenic derived from the condensation chambers at the works of the Canadian Consolidated Gold Mining Company, and at the Malone Mines. These mines, now closed for some years, were formerly worked for gold, the concentrates being said to contain about 25 per cent. of oxide of arsenic. The present production of arsenic is limited to the quantity of crude material obtained as above stated, and also by the small demand. Altogether some 650 tons of refined arsenic have been shipped from the Madoc region since the commencement of operations there. It is to be regretted that more is not being produced, as the Canadian material has been proven to be of very superior quality, owing to its entire freedom from impurities, whereas English and other arsenic frequently contains small amounts of zinc, tin or lead.

An analysis of a carload shipped from Madoc in 1887, gave, according to P. de P. Rickets, Columbia College:

| | |
|---|---|
| $As_2O_3$ (arsenious oxide) | 99·84 |
| Impurities | 0·16 |
| | 100·00 |

Two others by Baker Edwards, of Montreal, gave :—

| | |
|---|---|
| $As_2O_3$ refined | 97·5 |
| $As_2O_3$ crude | 92·8 |

The markets of the United States and Canada require about 6,000 tons per annum, nearly all of which is now supplied from England, though there is every probability that in the near future Canada will furnish a large proportion from the practically inexhaustible source of supply in Hastings county.

The amount produced during 1890 was 25 tons, valued at $1,500, or $60 per ton in New York.

The production for the past five years has been:—

| | Tons. | Value. | |
|---|---|---|---|
| 1886 | 120 | $5,460 | At the Mine. |
| 1887 | 30 | 1,200 | do |
| 1888 | 30 | 1,200 | do |
| 1889 | Nil. | Nil. | do |
| 1890 | 25 | 1,500 | do |

According to the report on the Mineral Resources of the United States, 1885, there were during that year 440 tons of crude and refined arsenic shipped from the Consolidated Company's mine to the United States.

The table of imports is given below.

ARSENIC.

TABLE 1.

IMPORTS.

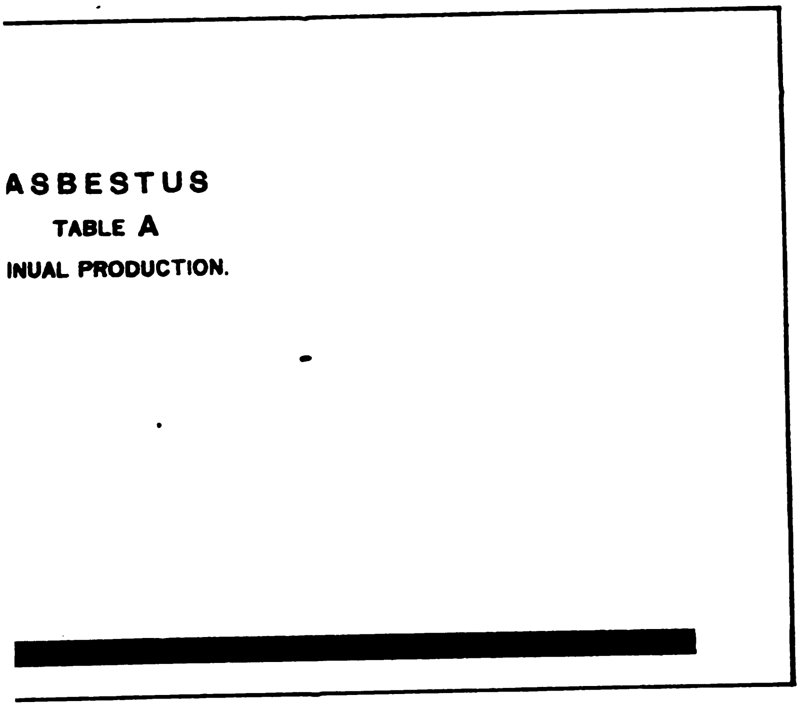
| FISCAL YEAR. | Pounds. | Value. |
|---|---|---|
| 1880 | 18,197 | $ 576 |
| 1881 | 31,417 | 1,070 |
| 1882 | 138,920 | 3,962 |
| 1883 | 51,953 | 1,812 |
| 1884 | 19,337 | 773 |
| 1885 | 49,080 | 1,566 |
| 1886 | 30,181 | 961 |
| 1887 | 32,436 | 1,116 |
| 1888 | 27,510 | 1,016 |
| 1889 | 69,269 | 2,434 |
| 1890 | 138,509 | 4,474 |

## ASBESTUS.

The production of this mineral during 1890 shows an encouraging rease of over 60 per cent in the amount and about 200 per cent. in the tal value, being for 1890, 9,860 tons, with a value of $1,260,240 as com- ted from returns received as compared [illegible]

Production.

PLATE I.



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The markets of the United States and Canada require about 6,000 tons per annum, nearly all of which is now supplied from England, though there is every probability that in the near future Canada will furnish a large proportion from the practically inexhaustible source of supply in [illegible] county.

## ASBESTUS.

Production.

Che production of this mineral during 1890 shows an encouraging rease of over 60 per cent in the amount and about 200 per cent. in the al value, being for 1890, 9,860 tons, with a value of $1,260,240 as comted from returns received as compared with a production for last year 6,113 tons, with a value of $426,554. (*See* Graphic Table A.)

Chis result has been brought about by improvements in plant, me- ›ds of extraction and especially by the stimulating effect of a considerle increase in prices, the value of a ton of the different grades ranging follows:—"Thirds," $20 to $50; "seconds," $75 to $100; "firsts," $125 $150, whilst extra quality of "firsts" ranged as high as $250; e margin of price for the same quality being due to the great difference ten existing between the equivalent grades from different mines.

Operations.

The operations for the extraction of this mineral are almost altogether nfined to the districts of Thetford, Black Lake and Coleraine in the ›unty of Megantic, P.Q., which are traversed by the Quebec Central ilway, although there are one or two detached mines outside of this in same general district of the Eastern Townships. The deposits are found in the areas of serpentine which are associated with the mbrian rocks of the district.

›r. R. W. Ells has made a special study of the asbestus deposits, ing several years spent in making investigations for the Survey, the ults of which may be found in the Annual Reports of the Survey. mode of occurrence of these deposits cannot be better given than by ting his description of them, in a paper read before the American titute of Mining Engineers, at its meeting at Ottawa, October, 1889, ere he describes as follows:—

R. W. Ells on "Asbestus Mines."

"The asbestus industry, although of comparatively recent date, has, ce its inception in 1878, rapidly increased in importance, and bids to speedily become the leading mining industry of the province. ile the occurrence of fibrous serpentine or chrysotile in the Townships been known for many years, and has been mentioned in the earlier orts of the Geological Survey, its true economic importance remained recognized, and it was not until the opening of the Quebec Central ilway across the serpentine belt of Thetford and Coleraine that any portance was attached to this peculiar mineral. Although occurring some extent with the serpentines of the Laurentian district, north of e Ottawa River, its development in this direction has not as yet been fficiently studied to warrant a clear expression of opinion as to the tual value of these areas, and the production of asbestus or chrysotile is as yet entirely confined in Canada to the Eastern Townships, and to the serpentine rocks which are at present regarded as forming a part of the volcanic belt of the lower Cambrian system of Quebec.

"This mineral differs entirely from the actinolite of central Ontario, and the asbestos of the Townships also presents several points of difference when contrasted with that from the Laurentian district. This is seen in the greater softness, silkiness and tenacity of the fibre of much of the former, a property which gives it great value for spinning and for its working into the finer variety of textures to which it is now so extensively applied.

"The stratified rocks associated with the serpentines of the Townships in which the workable asbestos occurs are generally slates of various colours, black, gray, green and purple, with occasionally conglomerate and sandstones, which are often hard and highly quartzose. These are frequently associated with diorites, which often form large mountain masses as at Orford, Ham, Broughton and other points, and which in texture are generally fine-grained, both massive and concretionary, and in colour, range through shades of green to brown.

Distribution.

"In the Province of Quebec the serpentine extends for many miles, in a series of interrupted outcrops from the boundary of Vermont, nearly to the extremity of the Gaspé peninsula. At several places, notably in Thetford and Coleraine, and in the Shickshock mountain-range of Gaspé it presents a large development. It is sometimes found in bands of a few yards in breadth, apparently interstratified with the slates and sandstones, and sometimes with diorites, in conjunction with which it forms knoll-like hills or elongated ridges of considerable extent. In many places a gradual transition from the diorites to the serpentines can be observed, and it seems very conclusively settled, both from observation in the field on a large scale and from analyses in the laboratory of the Survey, that much of the serpentine is an alteration-product from dioritic rocks, rich in olivine or some allied mineral. While generally massive, the rock has at times a slaty structure, and in many localities the mass is much shattered and broken. More especially is this latter feature noticeable in quarries or areas where dykes of diorite, but more generally of a whitish granite or granulite, cut the serpentine. This latter rock, which has generally a grayish or grayish-white colour, consists for the most part of orthoclase felspar and quartz, but at times contains an admixture of mica, classing with a true granite. Whatever may be the age of these whitish dykes, which frequently become masses of considerable extent, they certainly are newer than the serpentines which they traverse, as is evidenced clearly by the alteration and shattering of the mass traversed, along the contact. The view is held by many of those engaged in mining asbestus, that the presence of these smaller dykes exercises a favourable influence on the production and character of the veins, in the same way as the action of diorite dykes upon copper or other metalliferous strata on the production of ore-deposits.

"Among the principal areas of serpentine which are found at so many widely scattered points, the most easterly yet known is at a point called Mount Serpentine, about 10 miles up the Dartmouth River from its outlet in Gaspé basin. The serpentine is here associated with limestone and surrounded by strata of Devonian age. Small veins of asbestus are found in the rock, but not yet in quantity sufficient to be economically valuable. West of this the next observed is the great mass of Mount Albert, whence it extends west in a great ridge for some miles. This mass is known to contain veins of chromic-iron, and traces of asbestus have also been observed, but the area has never yet been carefully explored with a view to ascertain the presence of the mineral in quantity, owing largely to the present difficulty of access.

"In Cranbourne and Ware, to the north of the Chaudière River and in the vicinity of that stream between the villages of St. Joseph and St. Francis, several small knolls are seen, in all of which small and irregular veins are visible, but apparently not in quantity sufficient to render them economically important, at least in so far as yet examined. Further to the southwest, in Broughton, Thetford, Coleraine, Wolfestown and Ham, a very great development of these rocks is observed, forming at times mountain-masses from 600 to 900 feet above the surrounding country level, and presenting very peculiar and boldly marked features in the landscape by their rugged outlines and curiously weathered surfaces. The large areas of this division terminate southward at a point termed Ham Mountain, a very prominent peak of diorite which marks the extremity of the ridge. In this great area, which we may style the central area, asbestus can be found at many points in small quantity but at a comparatively few does it occur in quantity and quality sufficient to warrant the expenditure of much capital in its extraction.

"The third area, regarding that of the Shickshocks as the first, begins near the village of Danville, and may be styled the southwestern area. Thence it extends through Melbourne, Brompton, Orford, Bolton and Potton, in a series of disconnected hills, to the American boundary, beyond which the continuation of the serpentines can be traced into Vermont. In these areas, with the exception of the peculiar isolated knoll near Danville, the asbestus has, as yet, been observed in small quantity only, and generally of inferior quality. Large areas of soapstone are found at points throughout the area, and the associated diorites have a large development. It must, however, be said of this section, that considerable areas, whose outcrops can be seen along the roads which traverse the district, are concealed by a dense forest growth, and the true value of such portions must, for some considerable time, be largely conjectural. In fact, until the forest and soil are completely removed by the action of forest fires, as was the case at Black Lake and Thetford, the search for asbestus is likely to prove difficult and unsatisfactory. It is, however, very evident from the studies already made on this interesting group of rocks in Canada, that all serpentines are not equally productive—a fact very evident even in the heart of the great mining centres themselves, where large areas of the belt are made up of what is known as barren serpentine. As a general rule, however, the rock likely to prove asbestus-producing can be determined by certain peculiarities of texture, colour or weathering.

"At the Thetford mines, and in that portion of Coleraine lying to the northeast of Black Lake, certain conditions favourable to the production of asbestus appear to have prevailed, and have led to the formation of numerous veins, often of large size, which, in places, interlace the rock in all directions. These veins range in size from small threads to a width of 3 to 4 inches, and in rare cases even reach a thickness of over 6 inches. The quality of the fibre, however, varies even in these localities, and while much of it is soft, fine and silky, other portions are characterized by a harshness or stiffness which detracts greatly from its commercial value.

"Several theories have been put forth as to the origin of the asbestus veins. From a careful study of many places throughout the belt, it would seem that the theory of segregation applies equally to these as to quartz veins or other mineral lodes. The fibre of the veins, unless distorted by pressure, is always found at right angles to the sides of the fissure, and frequently in veins of what are regarded as of large size, say from two and a-half to four inches, the continuity of the fibre is broken by a dividing zone or comb, if one may use the expression, of grains of magnetic or chromic-iron. In certain cases, also, the mass of the serpentine appears to lose colour near the veins or in immediate contact with them, but this feature is not always observed.

"The fissures or veins are not always regular or persistent for any very great extent. A small vein at the surface, of half an inch in thickness, may quickly enlarge to one of three inches or more, and, continuing, may die out entirely, while others come in on either side. They have much the aspect of the gash veins in slaty rocks, though there are many instances are seen where the fibre maintains a tolerably uniform size for considerable distances.

"The containing rocks show the presence of numerous faults, as in other mineral localities, but possibly in the serpentine these are often more plainly marked. These faults throw the veins from side to side, and frequently are of sufficient extent to cut off entirely the working face of a highly productive area, the rock on the other side of the fissure being often entirely barren. The sides of the fault, in such cases, show extensive slickensides, and frequently have great sheets of coarse or woody-fibred, or imperfect asbestus, along the planes of fracture. Occasionally pockets or small veins of chromic iron are found in close proximity to the asbestus.

"Much of the asbestus found at the surface, or in the upper workings, is discoloured. This is generally the case where the rock is shattered by the action of the intrusive dykes, or from some other cause, and the colouring is doubtless due to infiltration of water along the lines of jointing or fracture, becoming less as the rock grows more solid. The quality of the fibre in such cases improves as the mine becomes deeper. A somewhat similar remark may be made as to the quality of the fibre at the surface as compared with that from a lower level, but proceeding from a different cause. Owing to the destruction of the forest over the serpentine-knolls by extensive fires or by the action of the weather, the asbestus veins, which are exposed at the surface, have frequently a certain amount of harshness, which entirely disappears as the vein is opened. This peculiarity is probably due to the action of the fire, by which a certain proportion of the contained water of the mineral is dissipated; and in this connection, also, a very interesting study is afforded by the comparison of the output at the Thetford mines with that from certain areas in the Black Lake District. At the former, the fibre is remarkable for its soft, silky character, and the percentage of harsh fibre is comparatively small. The same is true of certain of the Black Lake mines, but at others, though many veins of good size are also found, a very much larger proportion of the fibre is harsh or brittle. The cause of this difference has long been a subject of speculation to those more immediately interested in the subject, some attributing it to a difference in level of the two localities—a theory, however, which can scarcely be maintained in view of the fact that much of the output from the Black Lake mines, from the higher levels, is of the best quality.

"The presence, however, of large masses of the intrusive granulite near Black Lake, as contrasted with its almost entire absence at Thetford, where it is found generally in small dykes, leads to the inference that to this intrusion of heated matter may be largely due the lack of softness and silkiness in much of the Black Lake output. The presence of such great masses would have a tendency to dissipate a certain proportion of the contained water from the chrysotile, which is really a hydrous silicate of magnesia, in the same way as the action of the forest fires, though on a much more extended scale. The same effect can be produced by placing a piece of the mineral in the fire or on a sufficiently heated surface, when in a short time it will be found to have lost its softness to a large extent and become harsh and brittle.

"The extraction of asbestus in the present stage of the industry may rather be termed quarrying than mining proper, the workings so far being all open cuts. The rock is blasted out, broken up, carried to the dumps and subsequently cobbed by hand, the latter being generally done by boys. The smaller veins, of a-fourth to a-half inch, are frequently left in the rock of the dump, as not in the present state of the industry repaying the cost of extraction. There is no doubt that with suitable machinery for crushing and cobbing the greater part of most or all of the dumps, which have already reached a large size, would easily pay for working over, while the removal of the dumps themselves, from the fac of their covering much valuable ground, will very shortly become a necessity.

Thetford.

"The workings at Thetford are at present confined principally to four companies, viz.: King Bros., The Bell Company, Irving, Johnston & Co. and Ross, Ward & Co. These are all situated on a small knoll of serpentine which rises to a height of 80 to 90 feet above the adjacent track of the Quebec Central Railway which traverses the properties. The output from all these mines is practically the same in quality and length of fibre, though in the quarry of Irving, Johnston & Co., veins of extra width, nearly six and a half inches, have been found. This extra length of fibre does not, however, possess any special advantage, since it is generally broken by grains or partings of iron, and for practical purposes good clear fibre of two to three inches, or even less, is quite as valuable as any. In addition to the properties at this place above mentioned, new workings have lately been commenced by Mr. A. H. Murphy, now of Montreal, and by Luck & Mitchell, of Sherbrooke, both of which promise well. These are to the west of the railway, and at a lower level, and some extra work may be involved in the removal of a considerable covering of drift in places. The ground between the railway and the Thetford River, which here marks the western limit of the serpentine, has also been lately proved to some extent, and portions of it found to contain asbestus in satisfactory quantity, but the greater facilities for working the upper levels are such as to give them the preference for the present.

"At Black Lake, four miles south of Thetford mines, four companies are also located. These are the Anglo-Canadian, the Frechette-Dauville, the Scottish-Canadian, and the American Abestus Company, or Wertheim's, at all of which a large amount of work has been done. They are all at higher levels than the mines at Thetford, and the output, as already stated, is not, as a whole, equal in quality comparing the percentage of firsts produced. This will be seen from a statement of the relative percentages of the two districts, though this is again to a certain extent affected by the difference in grading practised by the several companies. Thus from the Thetford area the percentage of firsts ranges from 50 to 70; seconds, from 7 to 30; thirds, from 20 to 40. From the Black Lake district the percentages are: firsts, 10 to 50; seconds, 25 to 20; thirds, 20 to 60. Black Lake.

"Taking the scale of prices and the percentage of the higher grades, it is seen that at the present time, commercially speaking, the properties of Thetford are entitled to the first place. This is to some extent explained by the fact that a considerable proportion of the Black Lake output is off-colour, the areas worked lying partly below the crest of the main serpentine ridge and having a considerable covering of drift. At Thetford, owing to elevation of the knoll on which most of the mines are located, the loose or shattered rock, if it ever existed there, has been largely removed by glacial action, the surface of the rock being frequently polished and striated. It has always been expected that the Black Lake output would increase in value when the shattered surface rock was removed, and this expectation has, to a certain extent, been realized in so far as the workings have proceeded, the rock gradually becoming more solid at greater depths, and the colour and quality of the fibre improving. New workings along the face of the ridge at this place have also disclosed the presence of large veins of excellent material, and greatly superior to that from the lower works, yielding a large percentage of first quality. Here the action of the intrusive granulites has not been felt apparently to any considerable extent, and the conditions in this respect more closely resemble those prevailing at Thetford.

"In estimating the values of asbestus properties, the question of the relative percentages of output should be carefully considered, since, while the number of tons produced by two areas might be approximately equal, and to the uninitiated the properties in consequence be nearly equal in value, the one from the large amount of firsts would be capable of paying very handsome dividends, while the other would require great economy of management and yield far less satisfactory returns.

Danville.

"In addition to the areas just described, several others are worthy of notice. The knoll of serpentine near Danville, of small extent, has been worked for some years by Mr. Jeffrey, of Richmond, with good results. The veins at this place are not large, seldom reaching two inches in width, but the quality of much of the fibre is excellent, and, though small, a considerable number of them produce a good amount of abestus. The proportion of firsts from this mine is at present about 20 per cent., and of seconds 60 per cent., the remainder, of course, being thirds, thus approximating more closely the output of the mines at Black Lake.

"A more curious deposit however, is that known as the Broughton mine. The asbestus here is apparently confined to a single vein, having a hanging wall, in places, of soapstone. This vein was remarkable for its large size when first worked, being at times nearly or quite a foot thick, as well as for the great silkiness and softness of fibre. It had more the aspect of a well-defined vein, and has been worked for a distance of several hundreds of yards, and to a depth of about 70 feet. In the lower workings, however it decreased rapidly in size, and at last split up into minute strings, rendering it worthless. Another peculiar feature observed at one of the mines near Coleraine station is the presence of mica, or a similar mineral, associated with the asbestus veins, or in close proximity to them, and occurring in irregular fissures in the rock, of several inches in width. The rock is much shattered, and the mica is not, in so far as yet observed, found in any of the other mines in this section of the country.

"In many places the serpentine is intimately associated with masses of soapstone. In such cases, while occasional small and irregular veins of asbestus may be seen, in none of those examined has the quantity, with the exception of the vein at Broughton, just described, been found to be of much economic importance."

Methods of working.

The methods of working in the district are very simple, consisting in the opening up of large open pits or quarries from which the rock after a certain amount of selection in the pit is hoisted to surface, those portions containing the asbestus being further broken up and going, finally, to the cobbing sheds. Here, after the water has been driven off by heating on a sheet-iron drying table a force of boys select out the asbestus, further cleaning away the rock and classifying the product according to the length of the fibre into "firsts," "seconds" and "thirds." The grading adopted by the different firms varies very much both according to the length and quality of fibre each obtains. One of the leading firms, however, gives the following definition :—Firsts, over ½ inch; Seconds, ½ inch and under; Thirds, short fibre obtained by screening the refuse and re-picking it to free it from rock as far as possible.

There has been a tendency lately to recognize the necessity of adopting machinery in the treatment of the material especially of that carrying the shorter fibre, and the American Asbestus Company have installed a very complete works for the preparation of their product. Here the material as it comes from the quarry is placed in a very ingenious car with shelves, which is run on a track into a drying oven; the remainder of the process consisting of breaking the dried asbestus rock by means of stone breakers and grading through a system of sieves.

The mining is now mostly done by means of steam or compressed air drills, steam and horse derricks being used for hoisting.

Thetford.

At Thetford, the main workings are on a knoll on the east side of the railroad and here, within a radius of some ten chains, or so, are crowded over 20 pits often where belonging to different companies, with only thin walls of rock between. The waste rock has accumulated in large dumps around the pits and now that the more accessible ground begins to be worked out it is found necessary to remove it to get at the portions thus covered. In order to accomplish this steps are being taken by some of the companies to crush and work over these dumps, thus securing a large amount of asbestus that they contain and removing the waste to barren ground further from the workings.

None of the pits have attained any great depth as yet, the deepest probably measuring not more than 200 feet.

Recently, in several places, unexpected but encouraging results have followed on breaking through the large walls or faces of rock visible in the different pits which were believed for a long time to form the limit of the productive rock. This belief proved to be ill-founded and similarly in removing, to ensure safety, large portions of rock also believed to be barren good asbestus has been found in several cases.

Formerly, operations were mostly confined to the high ground, on the east of the railroad, at Thetford and Black Lake; but recently work has been begun at various points on the lower ground, on the other side with fair results, although, as far as the works have gone, the average of the fibre has been shorter than in the older working.

The chief mine, outside of these districts is situated near Danville, and continues to be worked by Mr. Jeffrey. A little activity is also evident in other portions of the district of which Dr. Ells who visited the localities, speaks as follows :—

Brompton Lake.

" *The Brompton Lake mine, which is the most southerly worked to any extent, has been open to a very considerable depth, and a large

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* Summary Report of the Geol. Surv. Dep., 1890.

amount of money has been spent; but the prospects for workable veins in the lower workings are no better than at the surface, and no returns have yet been made. About Orford Pond, on the south side of Orford Mountain, and near Long Lake, at the northern extremity of the same ridge, excavations have been made in thin and irregular seams a fourth of an inch, and in the road west from Knowlton Landing to Bolton Pass, in the serpentine band to the east of the Missisquoi River, some exploratory work has been done without finding asbestus of any economic value, and, in so far as yet ascertained, this portion of the province does not present favourable indications for profitable asbestus mining."

Operators

The names of the chief companies operating and producing in the Quebec district, who give employment to about 1,000 men, are as follows:—

| | |
|---|---|
| Messrs. King Bros., | Thetford. |
| The Bell Asbestus Co., | |
| Messrs. Ward, Ross & Co., | |
| The Beaver Asbestus Co., | |
| The Thetford Asbestus Mining Co., | |
| Andrew S. Johnson & Co. | |
| Messrs. King, Bros., | Black Lake and Coleraine. |
| The American Asbestus Co., | |
| Messrs. Irwin, Hopper & Co., | |
| The United Asbestus Co., | |
| Messrs. Steele & Co., | |
| The Laurier Mining Co., | |
| The Murphy Mining Co., | |
| Dr. Jas. Reed, | |
| The Megantic Mining Co., | |
| The Jeffrey Asbestus Mine. | Danville. |

The Scottish Canadian Asbestus Company of Black Lake, being still in liquidation, remained idle during the year, but hope to start again shortly.

A little prospecting for this mineral was carried on near St. Francis, Beauce, on the 1st range, S.W., near the Bras River, but, so far, no longer fibre than about ½ inch had been obtained. Prospecting operations in Pontiac county, on the north shore of the Ottawa River, in the vicinity of Calumet Island, are also reported, but with what result was not definitely ascertained.

Ottawa County.

The most interesting feature, outside of the progress in the main districts, is to be found in the work prosecuted with a view to testing deposits in the Laurentian rocks of Ottawa county. Some little work was done on the property of Mr. W. A. Allan, on lots 15 and 16, range V, Portland West. Here, numberless small seams of the mineral are found in the top of a ridge of serpentinized limestone. Only a small force, however, was at work, and enough had not been done to give a clear idea of the nature of the deposit.

**Templeton.**

A more extended effort is in progress in the Templeton district on lot 11, range VIII of that township. The mine is situated on a low flat ridge of limestone which has been cleared off by bush fires, so that the rocks can be easily examined. A most interesting structure here presents itself, a peculiar process of alteration having gone on, resulting in a reticulation of serpentine bands or seams throughout the limestone, cores of the latter being surrounded by the former. These cores seem to be clearly cut off from the enclosing serpentine ring, and when small can be lifted out leaving like the kernel of a nut a smooth cavity. The seams of asbestus generally follow the course of the serpentine band around the cores, although little cross seams occasionally traverse the band from side to side. A number of these serpentine bands of very varying sizes joining each other at intervals form the reticulation spoken of. The cores of limestone seem to be much more compact and harder than the general mass of the limestone around.

**Operation in Templeton.**

The work at this mine consists of a shaft or pit somewhat curved, as might be expected, sunk on one branch of a loop of serpentine of larger dimensions than the rest. This has been followed to a depth of 50 feet without showing any signs of giving out. The serpentine band at this spot with its accompanying asbestus veins has on surface been traced all round the central core, the outcrop of which is the shape of a flat ellipse, its larger diameter measuring about 50 feet.

The large proportion of the fibre, so far, is quite short, but of good quality; whilst a small quantity of "firsts," measuring up to two inches long and very clean and good, was also obtained. The accompanying serpentine shows very beautiful tints, delicate shades of green and amber prevailing. It is clear and semi-translucent, resembling wax. In cobbing, it breaks away easily and cleanly from the fibre, which is generally very clean and free from imbedded rocky impurities.

Only a small force was at work during 1896, as commencement was only made in the beginning of August, but already a boiler has been erected on the spot supplying steam to a machine drill.

The progress of these developments will be watched with great interest as being made to test not only a new district, but also a formation quite different from that of the now well proved areas of Thetford and Black Lake. There we are dealing with asbestus deposits developed n relatively extensive areas of serpentine, which would seem to have been subjected to extensive fracturing forces, the complicated set of fissures thus formed allowing free scope for the percolation of waters ar viding spaces for the deposition of serpentinous material in the form.

In the Laurentian districts so far examined the process of for seems much more obscure. The serpentinous matter is small portion to the predominating limestone rock, and would seem to rather to a quiet replacement of the carbonate of lime along certai by the serpentine, and there seems to be no evidence of any ext movement or fracturing.

It seems, however, quite possible that at places this alteration p will have gone on far enough to produce very considerable bodies serpentine, wherein the veins of asbestus may be found to be both plentiful and yield a larger proportion of longer fibre.

Exports

The exports and imports are given in Tables Nos. 1 and 2 below

ASBESTUS.

TABLE 1.

EXPORTS.

| Quality. | 1887. (a) | | 1888. | | 1889. | | 1890. | |
|---|---|---|---|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. | Tons. | Value. | Tons. | V |
| 1st class...... | 1,761 | $130,707 | 3,625 | $262,552 | 4,579 | $319,461 | 5,453 | $4 |
| 2nd do ..... | 566½ | 23,296 | 110 | 5,306 | 593 | 27,308 | 1,172 | |
| 3rd do ... | 184 | 4,826 | 201 | 9,884 | 416 | 13,375 | 373 | |
| Totals..... | 2,511½ | $158,829 | 3,936 | $277,742 | 5,588 | $360,144 | 6,998 | $5 |

(a) Second half of year only.

Imports

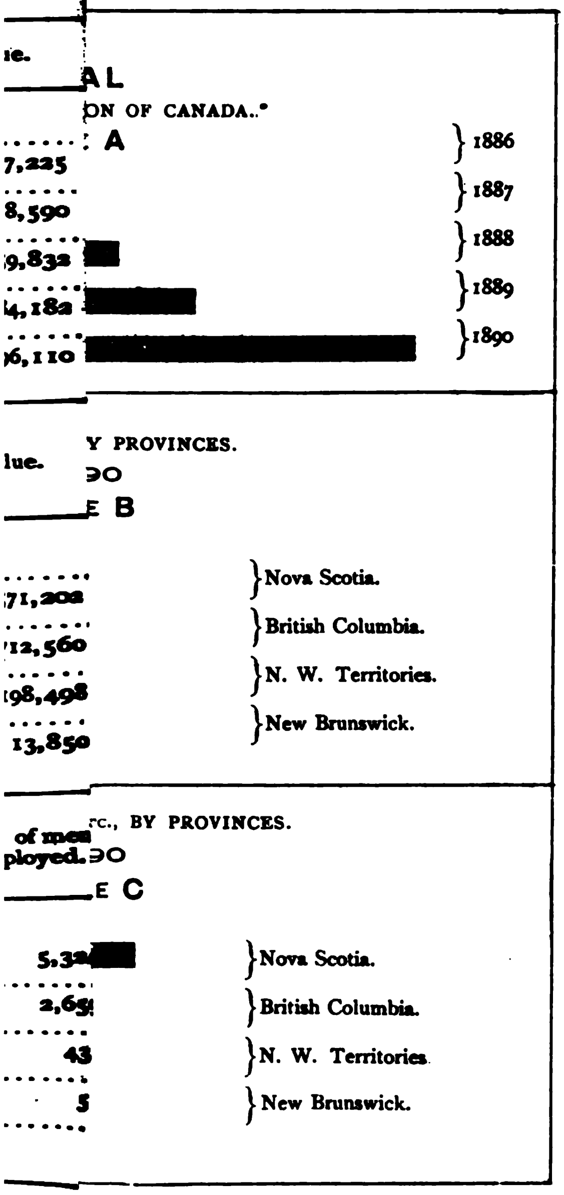
ASBESTUS.

TABLE 2.

IMPORTS.

| Fiscal Year. | Value. |
|---|---|
| 1885.................... | $ 674 |
| 1886.................... | 6,831 |
| 1887.................... | 7,836 |
| 1888.................... | 8,793 |
| 1889.................... | 9,943 |
| 1890.................... | 13,250 |

PLATE II.



ANNUAL REPORT 1889-90—VOL. V.

E. D. INGALL, M. E.

**Exports**

**Imports**

GE

| ar | Tons |
|---|---|
| 70 | 700,861 |
| 71 | 754,031 |
| 72 | 984,664 |
| 73 | 1,117,643 |
| 74 | 977,446 |
| 75 | 848,395 |
| 76 | 794,803 |
| 77 | 848,395 |
| 78 | 863,081 |
| 79 | 882,863 |
| 80 | 1,156,635 |
| 81 | 1,259,182 |
| 82 | 1,529,708 |
| 83 | 1,593,259 |
| 84 | 1,556,010 |
| 85 | 1,514,470 |
| 86 | 1,682,924 |
| 87 | 1,871,338 |
| 88 | 1,989,263 |
| 89 | 1,967,032 |
| 90 | 2,222,081 |

| ar | Tons |
|---|---|
| 74 | 81,574 |
| 75 | 110,145 |
| 76 | 131,192 |
| 77 | 154,052 |
| 78 | 170,846 |
| 79 | 241,301 |
| 80 | 267,595 |
| 81 | 228,357 |
| 82 | 282,139 |
| 83 | 213,299 |
| 4 | 394,070 |
| 5 | 365,596 |
| 6 | 326,636 |
| 7 | 413,360 |
| 8 | 548,017 |
| 9 | 649,409 |
| 0 | 759,517 |

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| ear | Ton |
|---|---|
| 873 | 420,6 |
| 874 | 310,9 |
| 875 | 250,3 |
| 876 | 248,6 |
| 877 | 301,3 |
| 878 | 327,9 |
| 879 | 306,6 |
| 880 | 432,1 |
| 881 | 395,3 |
| 882 | 412,6 |
| 883 | 486,8 |
| 884 | 474,4 |
| 885 | 427,9 |
| 886 | 520,7 |
| 887 | 580,9 |
| 888 | 588,6 |
| 889 | 665,3 |
| 890 | 724,4 |

| Year | Tons |
|---|---|
| 1873 | 5,4 |
| 1874 | 12,8 |
| 1875 | 14,0 |
| 1876 | 4,9 |
| 1877 | 4,8 |
| 1878 | 5,4 |
| 1879 | 8,4 |
| 1880 | 14,2 |
| 1881 | 14,2 |
| 1882 | 37,5 |
| 1883 | 44,3 |
| 1884 | 62,6 |
| 1885 | 71,0 |
| 1886 | 78,4 |
| 1887 | 89,0 |
| 1888 | 84,3 |
| 1889 | 89,2 |
| 1890 | 82,5 |

**Ex** [illegible]

**Im**

## COAL.

**Production.** rations were carried on during 1890 in Nova Scotia, British bia, the North-West Territories and New Brunswick and altogether 661 tons of coal were raised, value at the pit's mouth, $6,496,110. hows an increase in quantity over 1889 of 398,183 tons, and in value 11,928. Comparison with years prior to 1890 is given in the panying graphic table A. The production by provinces is also ically illustrated, and is given in table B, while table C shows the ge number of men employed as well as the number of tons mined an per annum.

production of Nova Scotia and British Columbia is given in ic tables D and E, respectively, while that of New Brunswick and orth-West Territories is given for the past four years in table 1, ing:

COAL.

TABLE 1.

PRODUCTION IN NEW BRUNSWICK AND NORTH-WEST TERRITORIES.

| Year. | New Brunswick. | | North-West Territories. | |
|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. |
| 1887 | 10,040 | $ 23,607 | 74,152 | $ 157,577 |
| 1888 | 5,730 | 11,050 | 115,124 | 183,354 |
| 1889 | 5,673 | 11,133 | 97,364 | 179,640 |
| 1890 | 7,110 | 13,850 | 128,953 | 198,498 |

**Exports.** statistics of exports are given in the following tables 2, 3 and 4, raphic tables F and G, which explain themselves:—

COAL.

TABLE 2.

EXPORTS: THE PRODUCE OF CANADA.

| Province. | 1889. | | 1890. | |
|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. |
| rio | 55 | $ 193 | 368 | $ 559 |
| ec | 7,249 | 17,848 | 12,599 | 32,233 |
| Scotia | 186,608 | 396,830 | 202,387 | 426,070 |
| Brunswick | 710 | 1,728 | 37 | 161 |
| e Edward Island | 9 | 32 | 142 | 478 |
| toba | 1 | 11 | 71 | 214 |
| h Columbia | 470,683 | 1,918,263 | 508,882 | 1,977,191 |
| Totals | 665,315 | $2,334,905 | 724,486 | $2,436,906 |

COAL.

TABLE 3.

Exports.

EXPORTS: NOT THE PRODUCE OF CANADA.

| Province. | 1889. |  | 1890. |  |
|---|---|---|---|---|
|  | Tons. | Value. | Tons. | Value. |
| Ontario | 72,008 | $173,382 | 63,251 | $150,2 |
| Quebec | 12,625 | 31,181 | 13,185 | 31,0 |
| Nova Scotia | 4,483 | 10,154 | 5,784 | 15,0 |
| New Brunswick | 178 | 500 | 136 | 39 |
| Manitoba | .......... | .......... | 178 | 80 |
| Totals | 89,294 | $215,217 | 82,534 | $197,5 |

Table 4 gives the exports annually since 1874 from Nova Scotia a British Columbia:—

COAL.

TABLE 4.

Exports: Nova Scotia and British Columbia.

EXPORTS: NOVA SCOTIA AND BRITISH COLUMBIA.

| Year. | Nova Scotia. |  | British Columbia. |  |
|---|---|---|---|---|
|  | Tons. | Value. | Tons. | Value. |
| 1874 | 252,124 | $647,539 | 51,001 | $278,180 |
| 1875 | 179,626 | 404,351 | 65,842 | 356,018 |
| 1876 | 126,520 | 263,543 | 116,910 | 627,754 |
| 1877 | 173,389 | 352,453 | 118,252 | 590,263 |
| 1878 | 154,114 | 293,795 | 165,734 | 698,870 |
| 1879 | 113,742 | 203,407 | 186,094 | 608,845 |
| 1880 | 199,552 | 344,148 | 219,878 | 775,008 |
| 1881 | 193,081 | 311,721 | 187,791 | 622,965 |
| 1882 | 216,954 | 390,121 | 179,552 | 628,437 |
| 1883 | 192,795 | 336,088 | 271,214 | 946,271 |
| 1884 | 222,709 | 430,330 | 245,478 | 901,440 |
| 1885 | 176,287 | 349,650 | 250,191 | 1,000,764 |
| 1886 | 240,459 | 441,693 | 274,466 | 960,649 |
| 1887 | 207,941 | 390,738 | 356,657 | 1,262,552 |
| 1888 | 165,863 | 330,115 | 405,071 | 1,605,650 |
| 1889 | 186,608 | 396,830 | 470,683 | 1,918,263 |
| 1890 | 202,387 | 426,070 | 508,882 | 1,977,191 |

The following tables 5, 6 and 7 show the amounts of coal annually ported into the Dominion since 1880 :—

### COAL.

### TABLE 5.

### IMPORTS OF BITUMINOUS COAL.

Imports Bituminous Coal.

| Fiscal Year. | Tons. | Value. |
|---|---|---|
| 1880 | 457,049 | $1,220,761 |
| 1881 | 587,024 | 1,741,568 |
| 1882 | 636,374 | 1,992,081 |
| 1883 | 911,629 | 2,996,198 |
| 1884 | 1,118,615 | 3,613,470 |
| 1885 | 1,611,875 | 3,197,539 |
| 1886 | 930,949 | 2,591,554 |
| 1887 | 1,149,792 | 3,126,225 |
| 1888 | 1,231,234 | 3,451,661 |
| 1889 | 1,248,540 | 3,255,171 |
| 1890 | 1,409,282 | 3,528,959 |

### COAL.

### TABLE 6.

### IMPORTS OF ANTHRACITE COAL.

Imports Anthracite.

| Fiscal Year. | Tons. | Value. |
|---|---|---|
| 1880 | 516,729 | $1,509,960 |
| 1881 | 572,092 | 2,325,937 |
| 1882 | 638,273 | 2,666,356 |
| 1883 | 754,891 | 3,344,936 |
| 1884 | 868,000 | 3,831,283 |
| 1885 | 910,324 | 3,909,844 |
| 1886 | 995,425 | 4,028,050 |
| 1887 | 1,100,165 | 4,423,062 |
| 1888 | 2,138,627 | 5,291,875 |
| 1889 | 1,291,705 | 5,199,481 |
| 1890 | 1,201,335 | 4,595,727 |

## COAL.

### TABLE 7.

### * IMPORTS OF COAL DUST.

Imports Coal Dust.

| Fiscal Year. | Tons. | Value. |
|---|---|---|
| 1880 | 3,565 | $ 8,877 |
| 1881 | 337 | 666 |
| 1882 | 471 | 900 |
| 1883 | 8,154 | 10,082 |
| 1884 | 12,782 | 14,600 |
| 1885 | 20,185 | 20,412 |
| 1886 | 36,230 | 36,996 |
| 1887 | 31,401 | 33,178 |
| 1888 | 28,808 | 34,730 |
| 1889 | 39,980 | 47,139 |
| 1890 | 53,104 | 29,818 |

* This table includes coal dust and all coal other than that specified as anthracite or bituminous.

Market in Canada.

Assuming that the imports, as given for the fiscal year, are equivalent to those for the calendar year, there is shown to have been a market for coal in Canada during 1890 equal to 4,974,362 tons as follows:—

| | Tons. |
|---|---|
| Production | 3,117,661 |
| Imports | 2,663,721 |
| | 5,781,382 |
| Less—Exports | 807,020 |
| | 4,974,362 |

Nova Scotia operators.

*Nova Scotia*—There were nineteen collieries producing, during 1890 as follows:—

| Collieries. | Lessees. |
|---|---|
| Chignecto | Cumberland Coal Mining Co. |
| Joggins | Joggins Coal Mining Association. |
| Salt Springs | |
| Springhill | Cumberland Railway and Coal Co. |
| Acadia | Acadia Coal Co. |
| Black Diamond | |
| East River | B. G. Gray. |
| Intercolonial | |
| Holmes | |
| Bridgeport | General Mining Association. |
| Caledonia | Caledonia Coal and Railway Co. |
| Francklyn | |
| Glace Bay | Glace Bay Mining Co. |
| Gowrie | Archibald Blowers. |
| International | International Coal Co. |
| Ontario | Halifax Coal and Iron Co. |
| Reserve | Sydney and Louisburg Coal and R.R. Co. |
| Sydney | General Mining Association. |
| Victoria | |

roduction of each of these is given in the following table which ə all those relating to Nova Scotia, taken from the report of the ır of Mines for that Province.

COAL.

TABLE 8.

NOVA SCOTIA.

PRODUCTION BY COLLIERIES, 1890.

| Colliery. | Tons. | Colliery. | Tons. |
|---|---|---|---|
| to | 11,336 | Francklyn | 810 |
| | 68,181 | Glace Bay | 124,848 |
| ings | 157 | Gowrie | 158,031 |
| ill | 469,293 | International | 160,262 |
| | 307,924 | Ontario | 10,135 |
| iamond | 37,270 | Reserve | 174,615 |
| ver | 1,523 | Sydney | 203,359 |
| onial | 120,668 | Victoria | 101,841 |
| | 65,303 | | |
| ort | 31,610 | Total | 2,222,081 |
| ia | 174,915 | | |

ə following tables certain statistical information is given relating oal trade of Nova Scotia, which wil! explain itself:—

COAL.

TABLE 9.

NOVA SCOTIA.

PRODUCTION, SALES AND COLLIERY CONSUMPTION.

| Period. | Production. | Sales. | Colliery Consumption. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| irst quarter .... tons.... | 364,428 | 239,264 | 37,357 |
| econd " .... " .... | 587,806 | 528,966 | 53,669 |
| hird " .... " .... | 647,488 | 677,441 | 47,167 |
| ourth " .... " .... | 622,359 | 554,773 | 42,396 |
| Totals .... " .... | 2,222,081 | 2,000,444 | 180,589 |
| " .... " .... | 1,967,032 | 1,741,720 | 177,106 |
| " .... " .... | 1,989,263 | 1,765,895 | 176,336 |
| " .... " .... | 1,871,338 | 1,702,046 | 156,550 |
| " .... " .... | 1,682,924 | 1,538,504 | 159,512 |
| " .... " .... | 1,514,470 | 1,405,051 | 142,939 |

## COAL.

### TABLE 7.

### * IMPORTS OF COAL DUST.

Imports Coal Dust.

| Fiscal Year. | Tons. | Value. |
|---|---|---|
| 1880 | 3,565 | $ 8,877 |
| 1881 | 337 | 666 |
| 1882 | 471 | 900 |
| 1883 | 8,154 | 10,082 |
| 1884 | 12,782 | 14,600 |
| 1885 | 20,185 | 20,412 |
| 1886 | 36,230 | 36,996 |
| 1887 | 31,401 | 33,178 |
| 1888 | 28,808 | 34,730 |
| 1889 | 39,980 | 47,139 |
| 1890 | 53,104 | 29,818 |

* This table includes coal dust and all coal other than that specified as anthracite o bituminous.

Market in Canada.

Assuming that the imports, as given for the fiscal year, are equivalent to those for the calendar year, there is shown to have been a market for coal in Canada during 1890 equal to 4,974,362 tons as follows:—

| | Tons. |
|---|---|
| Production | 3,117,661 |
| Imports | 2,663,721 |
| | 5,781,382 |
| Less—Exports | 807,020 |
| | 4,974,362 |

Nova Scotia operators.

*Nova Scotia*—There were nineteen collieries producing, during 1890 as follows:—

| Collieries. | Lessees. |
|---|---|
| Chignecto | Cumberland Coal Mining Co. |
| Joggins | Joggins Coal Mining Association. |
| Salt Springs | |
| Springhill | Cumberland Railway and Coal Co. |
| Acadia | Acadia Coal Co. |
| Black Diamond | |
| East River | B. G. Gray. |
| Intercolonial | |
| Holmes | |
| Bridgeport | General Mining Association. |
| Caledonia | Caledonia Coal and Railway Co. |
| Francklyn | |
| Glace Bay | Glace Bay Mining Co. |
| Gowrie | Archibald Blowers. |
| International | International Coal Co. |
| Ontario | Halifax Coal and Iron Co. |
| Reserve | Sydney and Louisburg Coal and R.R. Co. |
| Sydney | General Mining Association. |
| Victoria | |

roduction of each of these is given in the following table which e all those relating to Nova Scotia, taken from the report of the r of Mines for that Province.

### COAL.

### TABLE 8.

### NOVA SCOTIA.

### PRODUCTION BY COLLIERIES, 1890.

| Colliery. | Tons. | Colliery. | Tons. |
|---|---|---|---|
| to | 11,336 | Francklyn | 810 |
| | 68,181 | Glace Bay | 124,848 |
| ings | 157 | Gowrie | 158,031 |
| ill | 469,293 | International | 160,262 |
| | 307,924 | Ontario | 10,135 |
| iamond | 37,270 | Reserve | 174,615 |
| ver | 1,523 | Sydney | 203,359 |
| onial | 120,668 | Victoria | 101,841 |
| | 65,303 | | |
| ort | 31,610 | Total | 2,222,081 |
| ia | 174,915 | | |

e following tables certain statistical information is given relating oal trade of Nova Scotia, which will explain itself:—

### COAL.

### TABLE 9.

### NOVA SCOTIA.

### PRODUCTION, SALES AND COLLIERY CONSUMPTION.

| Period. | | Production. | Sales. | Colliery Consumption. |
|---|---|---|---|---|
| | | Tons. | Tons. | Tons. |
| irst quarter | tons | 364,428 | 239,264 | 37,357 |
| econd " | " | 587,806 | 528,966 | 53,669 |
| hird " | " | 647,488 | 677,441 | 47,167 |
| ourth " | " | 622,359 | 554,773 | 42,396 |
| Totals | " | 2,222,081 | 2,000,444 | 180,589 |
| " | " | 1,967,032 | 1,741,720 | 177,106 |
| " | " | 1,989,263 | 1,765,895 | 176,336 |
| " | " | 1,871,338 | 1,702,046 | 156,550 |
| " | " | 1,682,924 | 1,538,504 | 159,512 |
| " | " | 1,514,470 | 1,405,051 | 142,939 |

## COAL.

### TABLE 10.

### NOVA SCOTIA.

### COAL TRADE BY COUNTIES, 1890.

| YEAR 1890. | CUMBERLAND. | | PICTOU. | | CAPE BRETON. | | TOTAL. | |
|---|---|---|---|---|---|---|---|---|
| | Raised. | Sold. | Raised. | Sold. | Raised. | Sold. | Raised. | Sold. |
| | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. |
| First quarter | 151,886 | 137,850 | 113,275 | 94,499 | 99,267 | 6,915 | 364,428 | 239,264 |
| Second " | 139,132 | 122,443 | 131,437 | 114,349 | 317,237 | 292,174 | 587,806 | 528,966 |
| Third " | 74,319 | 67,703 | 150,200 | 147,032 | 422,969 | 462,706 | 647,488 | 677,441 |
| Fourth " | 183,629 | 163,245 | 137,788 | 126,290 | 300,942 | 265,238 | 622,359 | 554,773 |
| Totals... | 548,966 | 491,241 | 532,700 | 482,170 | 1,140,415 | 1,027,033 | 2,222,081 | 2,000,444 |
| 1889... ... | 549,294 | 469,983 | 483,145 | 429,500 | 934,593 | 842,237 | 1,967,032 | 1,741,720 |

## COAL.

### TABLE 11.

### NOVA SCOTIA.

### DISTRIBUTION OF COAL SOLD.

| Market. | 1889. | 1890. |
|---|---|---|
| | Tons. | Tons. |
| Nova Scotia :— | | |
| Transported by land........ .... | 351,995 | 390,322 |
| " sea........... ... | 264,481 | 283,869 |
| Total................ | 616,476 | 674,191 |
| New Brunswick..... ........ ..... | 218,595 | 251,749 |
| Newfoundland. ...... .. ........ .. | 98,048 | 107,557 |
| Prince Edward Island..... ....... . | 61,533 | 62,544 |
| Quebec... ...................... .. | 707,612 | 842,163 |
| West Indies. . ........ ........... | 4,461 | 5,284 |
| United States......... .... ......... | 33,584 | 56.956 |
| Other countries.... ............ .... | 1,411 | ......... .... |
| Total. ............... | 1,741,720 | 2,000,444 |

Nova Scotia developments.

Regarding operations in the province, the following notes are tak from the report of the Inspector of Mines above referred to:—

"*Pictou County.*—At the Intercolonial Colliery extensive workin were pushed into the Holmes area, and the coal found to be of g quality. Preparations are being made at this mine for erecting a pow ful hoisting engine to draw coal direct from the dip workings, and to away with the intermediate engine. Further work in the second se

Nova Scotia developments.

ls to the hope that next season it will furnish a large supply of coal ;ood quality. The manufacture of coke has been commenced here l the results are pronounced satisfactory.

" At the Black Diamond Colliery the extraction of pillars has been ıtinued.

" At the collieries of the Acadia Coal Company a new hoisting gine has been procured for the Acadia Slope. The work of reopening e Ford pit has been steadily carried out. The old workings have been lated, and the levels, etc., are being driven in the bottom coal, leaving over of twelve feet of coal between them and the old workings in the per portion of the seam.

' *Cape Breton County.*—Some prospecting was done in the rear of Big ıd, East Bay, Cape Breton County. The following analysis of coal s made for the Rev. M. A. McPherson:—

FAST COKING.

| | |
|---|---|
| Volatile matter | 41·79 |
| Fixed carbon | 44·98 |
| Ash | 13·23 |
| | 100·00 |
| Coke, per cent | 58·21 |

It yields a firm co-herent coke. The gases evolved during coking nt with a yellow smoky flame. Colour of ash, purplish brown. C. Hoffman (Geo. Sur., Canada).

*Other Counties.*—Discoveries of coal were reported from Parrsboro', nberland County, and from Middleton, Annapolis county.

'he following information also taken from the report of the Inspector Mines for Nova Scotia, is by Mr. Wm. Madden, Deputy Inspector for counties of Pictou and Cumberland, and relates to mines in those nties:—

*Pictou County.—International Coal Mining Company, Westville.*— ring the year an attempt was made to connect the workings of . 4 slope with the workings of slopes Nos. 1 and 2 for the purpose hoisting the coal to surface at one outlet. The water, however, ame so heavy that the sinking and other necessary operations in this had to be discontinued and the connection has not been made. In . 4 they continued drawing pillars until June, when work was ped, and the men were transferred to No. 1 slope, which was then ked double shift.

In March, the levels going south in No. 1 slope were driven to the ts of the area on that side, and beyond the barrier, into the adjoining .. In October, they started drawing the pillars near the line. About

Nova Scotia developments.

the same time operations were resumed in the Scott pit, with the idea of testing the coal, which is the second seam in this district, that is, it immediately underlies the seam or vein on which slopes Nos. 1 and 2 and 4 are driven, a vertical distance of about 300 feet separating them. It has been a general idea that this second seam or vein, to the dip, would improve in quality, and the management has fully determined to satisfy themselves upon this point. In this year much labour and care has been bestowed upon the air-ways in the old slopes (Nos. 1 and 2), by in many places repairing and enlarging them ; the results have been satisfactory. It has been decided to make further extensive improvements, by erecting larger and more powerful winding engines on the bank, enabling them to hoist not less than from twelve to fifteen boxes from a depth of from 4,000 to 5,000 feet, instead of only seven boxes, as heretofore, thus permitting them to do away with the underground engine at the 1,700 feet level. The old slopes have been timbered, and rails laid to the 3,300 feet level, in preparation for the changes.

"*Acadia Mines, Westville.*—Work has been very steady at this mine for the past year, pillar working in the 3,100 ft. lift forming the principal feature. It is now nearly finished, and has been very successfully prosecuted, a large percentage of coal having been obtained. In the next lift 3,560 feet, the levels on the north side have been driven 2,000 feet, and are now stopped. On the south side the levels have been driven some 2,500 feet and are still working.

"*Vale Colliery, Acadia.*—McBean Seam.—At this mine, which unfortunately about a year ago caught fire, the coverings of the Travelling slope and East intake were removed on the 22nd March, and left open for a few days, when, the temperature beginning to rise rapidly, it was deemed best to close them up again. It has remained in this situation since that time.

"Six Feet Seam.—Work has not been very actively prosecuted here. In August, in the west side, 3rd Balance, 1,000 ft. lift, they began drawing the pillars. The levels going east and west on this lift were stopped. In the lower lift the levels on both sides are being driven.

"*McGregor Pit, Stellarton.*—At this pit they have been opening up the lower lifts ; the coal is strong and gives off considerable gas, so that it was found necessary to prohibit the use of powder on the lower lift, south side. This made a very difficult job of driving the balance. They have, however, succeeded and started eleven bords on south side balance. The balance west side of south slant is up and bords started off; the air being increased by getting those places through, so that powder is now again used in the lower shift, south side. The balance on south side north slant is also driven up, and air likewise increased largely. The pillars along the crop have been very successfully won. A new place has been driven to the surface with the view at some future day to utilize it for a hoisting slope, doing away with the shaft and underground engines.

Nova Scotia developments.

"*Douglas Slope.*—No. 2.—This slope has been cleaned up and timbered. On 1st September the mine bords and levels going east and west were started to work. The drift which, about six months ago, was driven with the aim of catching the Cage-pit seam, has been excavated through rock and stone, etc., a distance of 250 feet, at which point the cage-pit seam was struck, thus winning a large field of coal for this slope to handle. Boreholes to tap the drift connecting the cage-pit and Foord pit were put through, and the water of 3rd seam is now running to the Foord pit.

"*Black Diamond Mine, Westville.*—This mine has been kept pretty steadily at work during the year, pillar working forming the principal feature. They began some 1,500 feet down the slope drawing the pillars that had been left to support the travelling and main slopes, and are succeeding in getting some very fine clean coal.

"*Lawson Mine.*—A small amount of work has been done here during the year. The ventilation (natural) during July and August gave some trouble. Their pump is not of sufficient capacity, and, in consequence, the water gave them difficulty. Some prospecting was done in the month of October. Twenty-five men were employed in December.

"*Minudie.*—Ten or twelve men worked here for the first three months of the year, taking out some very good coal, supplying local demands; it then remained idle from March to November, when work was again begun, and at my visit in December, twelve men were employed.

"*Chignecto.*—This mine worked on in the usual way until July, when most of the men were dismissed. Some 19 or 20 were, however, retained prospecting until late in the fall, when Mr. Frank Burrows, underground manager, took these men and began taking out coal along the crop-out on the eastern side of their works, and as it can be got water dry, the idea is to keep these men employed for the winter months in readiness for prospecting next spring.

"*Scotia*—Alexander Dewar began taking coal out of what was formerly known as the Scotia area, and on my visit in December he had 3 or 4 men employed."

From the statement of Mr. P. Neville, Deputy Inspector for Cape Breton Island, the following notes have been taken, which will illustrate the year's operations in that part of the province :—

Nova Scotia developments.

" *Gowrie Mines.*—Work has been carried on its usual way, levels extended on both sides of the low lift and rooms broken off. On No. 1 lift west side, the levels have been driven about 99 feet parallel to the stone troubles; it is found, as they advance, that the coal is dipping slightly to the south-west, so that the course of the levels are now going more northerly, gaining more grip on the seam. The management say it is their intention this winter to drive through and come out on the opposite side of the basin.

" *Ontario Mines.*—During last winter pumps were placed below No. 1 level for the purpose of drying the dip workings. The water was lowered by the 10th of June a distance of 200 feet to No. 2 level, and up to the last of September it was lowered to No. 3 level, a distance in all of 460 feet. From that date the pumps seemed to be getting out of order and the water raising. Finally work ceased on the 31st of October and pumps and pipes removed to the surface. The coal mined here during the season was taken from No. 2 section, north side between No. 1 and No. 2 levels. A few pillars have been drawn up and split in No. 3, north side; also six rooms were worked at the face of the solid coal, below No. 1 level, south side.

" *Caledonia Mines.*—Work has been brisk at this mine during the last season. The main deeps have been driven down 300 feet; No. 2 levels, above this, have been extended on the west and east sides, and rooms broke off and worked. A slant road has been driven from this east level coming out at the east side of the pit, for the purpose of drawing coal from that section. A small section of pillars have been drawn and split in the east side rise workings. A new double engine has been imported and placed on surface east of the hoisting shaft for the purpose of drawing the coal from the deeps. Also, preparations are being made to put a double furnace where the single one is now.

" *Little Glace Bay.*—The operations at this colliery during the year has chiefly been the extension of rooms already gained and worked off the levels. The rooms south of the 1,800 feet headway have been worked, and some of them drawn up to the Harbour pit workings.

" *International Mines.*—The pit bottom has been re-timbered; the back deeps have been driven, connecting No. 9 landing; laid and worked No. 8 and 9 landings. No. 6 section has been driven seawards to the barrier and stopped; south side drove and laid angle deeps, from pit bottom level to No. 1 landing on incline deep.

" *Reserve Mines.*—During last winter the east slope was driven down and a new lift of 600 feet gained, and levels turned off east and west. The west levels were driven three chains, and the east eight; back deeps

Nova Scotia developments.

were also driven and rooms broke off and worked parallel to the level. A new travelling road has been made up the back deep on east side. The barrier between No. 2, east side level, and No. 6, west side, has been pierced for the purpose of letting off the water from that section, which had been filled for a number of years. This done, it was found that the pump on the east side was not equal to the task, and a new pump has been placed at the bottom of the west slope to dry No. 6.

" *The Emery Mine*, which had been idle for a number of years, and full of water, has this year been pumped out, and a pump placed below the bottom of the pit, by which the water is pumped up the shaft to the surface. This shaft has been repaired, and slides and cages put in. The coal is raised to bank in half-ton boxes. A bank-frame and engine-house have been erected, and an engine and boiler placed therein; also, a branch railway of 400 yards has been built, connecting with the Reserve road. The levels in the west side of the pit have been driven about 700 feet, and headways driven towards the rise; rooms broke off and worked; these rooms are eighteen feet wide; pillars eighteen feet thick; cross-cuts twelve feet, and sixty feet apart. On the east side, the old levels and rooms have been extended, and a pair of dip-slants is being driven, in order to gain a lift of 600 feet.

" *Old Bridgeport.*—Levels and rooms have been extended on the south side of the pit. No mining has been done during the year north of the furnace headway. The band of the shale, spoken of in last year's report, was found to be quite thin in the levels or low rooms, and consequently it was taken down with the top coal, which made the seam about nine feet thick. However, as the levels advanced it was found again to thicken, and the management thought it more profitable to timber and keep it up than take it down. A section of pillars have been drawn from south of mine headway.

" *Gardner Mines.*—This property has been acquired by Messrs. Burchell Brothers. This property has been closed down since 1879, previous to which it was worked by the Gardner Coal Company. It was thoroughly equipped with the best machinery, some of which are still in excellent condition. Work commenced there in the latter part of the summer, getting everything in order to be ready for shipping at the opening of navigation next spring. Engine houses and miners' cottages are being erected.

" *Victoria Mines.*—Work has been carried on at this mine in its usual steady way during the year. The east dips have been extended and a lift of 600 feet gained; this lift being free from water is completely dry; levels have been turned off east and west, and driven 150 yards. A

Nova Scotia.

balance was driven upon the east side and rooms broke off. The levels on No. 2 lift are still being extended in driving up the balance.

"*Sydney Mines.*—I am glad to state that a great improvement have been made in this pit during the year for the safety of men's lives. New travelling ways have been made on the south side, a distance of 1,700 yards. On engine and incline planes, where the roadway was found narrow, additional manholes have been driven between the ones there already, according to law. On the north side bankhead landing, where the road was narrow, the place has been made wider for 300 feet, so that there is now ample room to pass the standing or moving trips. No. 3, or pump deep, has been working since the 27th of May last. This is one of the submerged districts. The deeps have been extended 300 yards in solid coal, and rooms broken off right and left and worked."

The value of Nova Scotia coal has been computed at $1.80 per ton of 2,240 pounds at the pit's mouth, or $1·607 per ton of 2,000 pounds.

New Brunswick.

*New Brunswick*—A small quantity of coal was raised in this province during the year, and was the result of the operations of fourteen producers in the neighbourhood of Grand Lake, Queen's and Sunbury counties, from whence it is shipped principally to St. John. The seams are small, and the work of a desultory character, being carried on principally by farmers, who, during the winter months and between the seasons of sowing and harvesting raise small quantities from pits sunk on their properties.

North-West Territories.

*North-West Territories.*—Returns were received from seven producers, the principal one being the Alberta Railway and Coal Company, operating at Lethbridge, Alberta, the others being in the vicinity of Calgary and Edmonton, where small seams are worked to supply local demands.

Large deposits of coal have been located in the vicinity of Canmore and between that point and Anthracite, and it is confidently expected that the new discoveries, as well as the older workings at Anthracite, will be operated during the present year, as it has been found that the anthracite and semi-anthracite afforded by these deposits are of very superior quality.

Regardingg the deposits at Canmore, Dr. Selwyn, in his summary report for 1890, writes:

"On the 29th of August a short time was spent at Canmore to look at the coal mines newly opened there on the seams on the right bank of the river described, pages B–132 and 133, Annual Report, Geological Survey, Vol. 1, 1885. The three feet seam is now being worked by a slope which starts on a terrace about 200 feet above the river, where a small outcrop of the measures is exposed dipping 50° to 60° to westward. In a level being driven in to the hill to cross cut the seams, about 100 feet below the slope, the dark shales associated with the coal had been struck at about 30 feet in dipping 30° to north-east, so that there must be either a fault or a steep anticlinal fold along the face of the hill. The coal is much crushed and slickensided. It is apparently a semi-anthracite, like that from Cascade River--see analysis, Part M., Annual Report, Geological Survey, Vol. 1, 1885. There can be little doubt that the Canmore seams are the extension of those of Cascade River and Anthracite on the opposite side of the Bow River valley. The mine is already connected by a branch railway with the station at Canmore; an incline tramway and shipping stages have been constructed at the mine and there is now every convenience for handling a large output."

Dr. Selwyn also visited the Turtle Mountain coal area, of which he writes, in the above referred to report, as follows:—

"In the Turtle Mountain coal field, range 24, township 1, several pits and bore holes have been sunk and in all seams of lignite-coal of workable thickness have been struck. In one pit, now full of water, but said to be 50′ 6″ deep, strata are stated to have been passed through as follows:—

| | Feet. | Inches. |
|---|---|---|
| Surface | 3 | 0 |
| Dark clay | 4 | 0 |
| Coal | 5 | 6 |
| Clay shale | 10 | 0 |
| Coal | 3 | 6 |
| Sandy brown shale | 6 | 0 |
| Soft whitey brown sandstone | 2 | 0 |
| Sandy clay | 6 | 0 |
| Coal | 1 | 6 |
| Friable whitey brown sandstone | 12 | 0 |
| Bored from bottom of shaft--sandstone | 20 | 0 |
| | 73 | 6 |

"In another pit, 150 yards south of the one above described and about 15 feet higher, the coal was struck at 40 feet 4′ 6″ thick, then 12 feet sandy shale and thin bands of iron ore; coal 1′ 6″ then bored 25 feet through sandy shale; total 78′ 6″. This is the only pit from which any coal has been raised. An engine with winding gear and shaft house have been erected here and a few tons of coal raised. This section is probably the most reliable, and omitting the upper 5′ 6″ seam of coal given in the first section, which is probably a mistake—the two sections are much alike. The coal or lignite, like that of the Souris at Roche Percée, slacks on exposure and would not bear distant transport. The seams probably underlie the whole of Turtle Mountain, except where deep ravines have been cut out and have been filled in again with the superficial drift deposits. They will probably be found in places in township 1 from range 19 to 24. They could be mined at small cost, and for use among the settlers in the treeless country to the north and north-west between the Souris River and the Mountain would prove a cheaper and more economical fuel than wood.

"I examined this district in 1883, and in the Summary Report for that year, page 2, it was stated 'the evidence obtained clearly shows that there is every likelihood of workable seams being found here, as on the south flank of the mountains, at the head of Willow Creek in Dakota a seam has already been found showing from 3 to 5 feet of lignite of fair average quality.' The seams now opened are doubtless the extension of those above referred to on Willow Creek, and as soon as railways are constructed to the mines, the lignite could be very advantageously distributed over a wide extent of country in which wood is even now scarce and costly, and yearly becoming more so."

British Columbia.

*British Columbia.*—The production of coal in British Columbia is that of four collieries, viz.:—

| | | |
|---|---|---|
| Nanaimo Colliery, | owned by | The New Westminster Coal Mining and Land Co. |
| Wellington " | " | R. Dunsmuir & Sons. |
| E. Wellington " | " | East Wellington Coal Co. |
| Union " | " | Union Colliery Co. |

Statistics regarding their output are given in the following table 12, for comparison with which a similar table, No. 13, published for 1889, is given.

COAL.

TABLE 12.

BRITISH COLUMBIA.

PRODUCTION, SALES, &C., FOR 1890.

| Name of Colliery. | Coal raised. | Sold for home consumption. | Sold for exportation. | On hand, 1st Jan., 1889. | On hand, 1st Jan., 1890. | Number of men employed. |
|---|---|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. | Tons. | |
| Nanaimo...... | 436,246 | 110,141 | 327,946 | 10,744 | 6,802 | 1,493 |
| Wellington..... | 195,436 | 78,141 | 119,035 | 3,416 | 2,794 | 646 |
| E. Wellington.. | 49,954 | 9,502 | 39,348 | 612 | 1,605 | 170 |
| Union. . .. | 77,881 | 1,659 | 82,933 | 10,431 | 3,720 | 350 |
| Totals... . | 759,517 | 199,443 | 569,262 | 25,203 | 14,921 | 2,659 |

### COAL.

### TABLE 13.

### BRITISH COLUMBIA.

### 1889.

| Name of Colliery. | Coal raised. | Sold for home consumption. | Sold for exportation. | On hand, Jan. 1st, 1889. | On hand, Jan. 1st, 1890. | Number of men employed. |
|---|---|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. | Tons. | |
| anaimo...... | 250,735 | 44,929 | 200,800 | 5,736 | 10,744 | 875 |
| Vellington.... | 306,189 | 85,707 | 221,011 | 4,145 | 3,416 | 862 |
| . Wellington.. | 57,537 | 8,552 | 48,259 | 112 | 612 | 190 |
| nion...... | 34,948 | 112 | 26,645 | 2,240 | 10,431 | 314 |
| Totals .... | 649,409 | 139,298 | 491,715 | 12,233 | 25,203 | 2,241 |

British Columbia developments.

Regarding the operations and development in British Columbia during e year, the following notes are taken from the report of the Minister Mines of that province :—

*Nanaimo Colliery.*

"The coal from this colliery was in good demand during the past year.

"*No.* 1 *Pit*, *Esplanade*, *in Nanaimo.*—This mine, forming part of the anaimo Colliery, belongs to the New Vancouver Coal Mining and Land ompany (Limited). As in the previous year, the workings in this pit avo been from what is known as No. 1 and No. 3 North Levels. All e workings from these levels are under the water of the Nanaimo Harour, and are getting to be very extensive. The No. 1 Level with its windigs is in about 2,800 yards from the shaft in a north and westerly direcon. In this division of the mine they have taken much coal during the ast year, the coal being of a first-class quality, hard, and will average bout seven feet thick. They have drifted or run the level in about 800 ards, without a fault or hitch of the smallest kind. Here they have as any employed, considering the distance, as they can take coal away om; and at present they have coal won where they could employ 100 ore men than what are now employed in this district of the mine. At e back of the level they are only a few yards from working under Proection Island, under all of which, I have reason to believe, lies this mous and valuable coal. In No. 3 level there has been much prospecng and exploring done. They are now getting out a considerable uantity of good coal, but they do not seem to have got into the extenve field where No. 1 is, although they are working towards it and exect to get in soon.

British Columbia developments.

"*No.* 3 *Pit: (Chase River), Nanaimo Colliery.*—This is mentioned in a previous report as being near to the mouth of Chase River. With the exception of a short stoppage in the early part of the summer this mine has been worked steadily. The coal from here is of a very good quality, and hard. As it is worked on the pillar and stall system and that by a slope, and having got as far as it is intended to go at present, all the mining is at the pillars (coal), which were left behind to support the roof; those pillars being fully one-half of the coal that was in the mine at the start, so that there is yet a large output to be got here.

"*South Field Mine, No.* 1 *and No.* 2.—These mines are now what are known as the South Field mine.

"This mine is worked by a slope from the surface, and is now down about 800 yards, but at present it is not worked in the bottom, and nearly all the coal came out from the south side. It has been the greatest producing mine of the colliery. This coal is of a very good quality, and in some parts is about 18 feet thick, but as in the other mines it had faults now and again to contend with. The coal is mined on the pillar and stall system.

"*No.* 4, *South Field Mine.*—This is the slope mentioned in a former report, and about half a mile from No. 3 pit. It is down about 1,000 yards with a long level to the south side. The company have been to a great expense here, and at times prospects looked favourable, and it was reasonably expected that good coal would be early found here, as they have good coal coming this way from No. 3, and also from bores they put down away to the dip only a few hundred yards ahead; yet, with all those encouragements, the prospects are not looking very favourable; but it is to be hoped that there will before long be a profitable mine here, the location being good, and well situated for other works.

"*No.* 5, *South Field Mine.*—This is a new shaft which the company are putting down to the dip and north of the working of No. 2 slope, after having put down a series of bore holes. The prospects from those holes gave them encouragement to start the above shaft, which is now down 100 feet; and they expect to reach the coal a little over 500 feet from the surface. As the company have got machinery and head gear up, to be used in the sinking, it may be expected that, in the absence of unforeseen accident, the company will get to the coal early in the summer, and this will be quite an acquisition to the proprietors.

"*North Field Mine, Nanaimo Colliery.*—This mine is mentioned in a previous report as being in the northern part of the New Vancouver Coal Company's extensive estate. The mine has been worked contin-

British Columbia developments.

ısly during the past year, the coal varying in thickness from three to feet, and is very hard and of a very good quality. It is in good nand both in the Victoria and California markets, and commands the ;hest price.

' During the past year the company have been sinking another shaft, ich is about 70 yards west of the hoisting shaft, and had got down to › coal and connected with the works at the end of December, so that :e they get these works arranged this second shaft will be their return up-cast shaft, and will also form a second connection or outlet with › surface. Little or no gas has ever been seen in this mine."

*Wellington Colliery.*

' *No.* 3 *Pit, Wellington Colliery.*—This pit, as has been mentioned in ›revious report, is in the valley of the Millstone River. The workings › all by way of a slope from the south side of the shaft.

' In this pit much of the work is under the valley, which is some-ıes overflowed at very high stages of the river. As well as mining lerneath the valley, a great deal of work has been done below the ;h bluff overlooking the valley. The workings here have only been at lars (coal), and that under the bluff, as it is not the intention of the ınager to take any of the pillars from under the valley, until every ıer part is worked out; this is done as a safeguard against an inflow water from the surface. They were working at the pillars up to the th May, when there was a strike, and up to the present time there has t been any coal taken out of this mine. Water was being pumped t as usual up to the 26th August, when I was there and went down the ne with Mr. Bryden, the manager. We were satisfied that the gob s heating from the steam and smoke that travelled along the return ·way.

" *No.* 5 *Pit, Wellington Colliery.*—This is about the most extensive ne in this colliery. The coal is worked here from the east and west es, also from an incline on the south, and a slope to the north. As s has been on the pillar and stall system (with the exception of part the slope that is long wall), there has been much good coal worked :e. Now at the south incline and west side, all the mining is at the lars, which contained about two-thirds of the entire coal; but of course ıre are many of them by this time taken out. On the east side they working in the solid coal, and also at the pillars. Down the slope the north the long wall system works well, but it has to be closely ended to.

British Columbia developments.

"In this slope there is also a considerable amount of work done on the pillar and stall system. Down this slope and also in the east level there is the prospect of having a very extensive mine for many years to come.

"*No. 6 Pit, Wellington Colliery.*—This is the same mine as mentioned in a former report, and about 900 yards east of the No. 4 Pit. Although working, the two shafts are only a short distance from each other; but that small piece is to remain, as it is not the manager's intention to connect those works for some time. This is going to be a very extensive mine, the coal almost lying flat, so that the working is all around the shaft, with a great extent to spread out. The coal is very good and hard, from six to eight feet thick, and worked on the pillar and stall system, which seems to be the best way of mining in this colliery, all things being considered.

"*No. 2 Slope, Wellington Colliery.*—There has been little or no coal mined or work done here during the past year, but the company intend to resume work early in the spring.

### *East Wellington Colliery.*

"This property of the East Wellington Coal Company comprises two shafts, known as No. 1 and No. 2, which are in the valley of the Mill-stream. The shafts are about half a mile apart by a direct course, and are worked as one mine.

"In No. 1 Pit, coal only comes from a few men, and that from the west level, towards the No. 2. The coal is of the usual good quality, and hard, but the company are much troubled with faults of one kind and another. On the east side they are now in a long distance which has proved one continuous fault, with a little black dirt here and there; but as this side is the greater part of their estate, they are determined to find out what is in it, and it is to be hoped that they will yet find a good piece of valuable coal as they have incurred a large outlay. I might say it has been up-hill work all the way.

"*No. 2 Pit, East Wellington Colliery.*—In this pit the company have been working steadily all the year, except for a day now and then. The coal has kept good, and is in good demand in San Francisco, where most of it goes.

### *Union Colliery, Comox.*

"This colliery belongs to the Union Colliery Company. The mines are only a few miles from Comox. This company are working two veins of coal, two mines, known as No. 1 and No. 2 tunnels, or adit levels, going in on the hill side on the south side of the railway, and high above its level. Both of these levels are in about 600 feet, in good hard coal, and from two three feet thick, overlaid by a strong sandstone. The mines here are on the pillar and stall system, and are very safe workings.

British Columbia developments.

"*No.* 1 *Slope, Union Colliery.*—This slope, which is now down about 2,000 feet, has not been extended any distance during the past year, but the levels from it to the north side have been working steadily the most of the year, that is by three levels with the stalls therefrom. The coal has kept good and very hard, and improving a little in thickness, being from three to five feet thick, with a strong roof. There are good indications to show that this seam of coal will improve in thickness, going to the north.

"*No.* 1 *Shaft, Union Colliery.*—This is the shaft mentioned in a former report. There has been much prospecting done here during the past two years, but there has been very little coal taken out. Now it is looking better, and the company have the prospect of yet getting good workable coal, and it is hoped that they will do so after going to so much expense.

"*No.* 2 *Slope, Union Colliery.*—This is a new mine, started during the past summer, and about one mile north of No. 1 slope. Here the coal was easy to get at, and now the company have put a slope down 260 yards. The coal will average six feet thick. This coal is very hard, of good quality, and resembles the Wellington coal, and I may say that it is the most valuable strike of coal that has been made here by this company, and is a good thing for them, also for the settlers of the extensive district of Comox, as well as for the province in general. The company have put down a series of bore-holes away ahead of this slope, which have proved the coal for a long distance.

"*New Vancouver Coal Mining and Land Company, Limited.*—The workings from the No. 1 shaft have now got through under the harbour, with one and three-quarters of a mile to haul the coal, this being about under Protection Island. There was a bore-hole started in this island about three months ago, and pushed with all haste. When at the depth of 588 feet coal was struck, and as it was gone through it proved to be a good workable seam. After going through this, the bore-hole was continued, and at the depth of 650 feet from the surface another seam of coal was struck, which was thought to be a continuation of the first seam of coal that was worked on Newcastle Island, and also in the old No. 3 Pit, Front Street, Nanaimo. As the coal from both those places was of a good quality, there is no reason to think that it is not as good under Protection Island and the waters of Nanaimo Harbour. Near to this bore-hole the company is preparing to sink a shaft, making every preparation to start, so as to lose no time, in order that they may be able to ship coal from this island at as early a date as possible. There is now a wharf built on the island for landing the machinery and materials."

Coke.

*Coke.* During the year there were produced in Nova Scotia 56,450 tons of oven coke, valued at $166,298, the greater part of which was consumed in the manufacture of iron at Londonderry, N. S. In no other province is oven coke produced, though gas coke is, of course, made in all cities where coal is used in the manufacture of illuminating gas; the coke so obtained being sold locally, whilst no returns of production were collected.

According to direct returns the production during the past year has been,—

| | | | |
|---|---|---|---|
| 1886 | 35,396 | tons valued at | $101,940 |
| 1887 | 40,428 | " " | 135,951 |
| 1888 | 45,373 | " " | 134,181 |
| 1889 | 54,539 | " " | 155,043 |

The following table shows the imports of oven coke since 1880:—

COKE.

TABLE I.

IMPORTS OF OVEN COKE.

| Fiscal Year. | Tons. | Value |
|---|---|---|
| 1880 | 3,837 | $19,353 |
| 1881 | 5,492 | 26,123 |
| 1882 | 8,157 | 36,670 |
| 1883 | 8,943 | 38,588 |
| 1884 | 11,207 | 44,518 |
| 1885 | 11,564 | 41,391 |
| 1886 | 11,858 | 39,756 |
| 1887 | 15,110 | 56,222 |
| 1888 | 25,487 | 102,334 |
| 1889 | 29,557 | 91,902 |
| 1890 | 36,564 | 133,344 |

Peat.

*Peat.* In his summary report to the Director of the Geological Survey for 1890, Mr. Robert Chalmers makes the following mention of extensive deposits of peat in that part of New Brunswick in which he was making investigations during the year:—

"Peat is found in extensive bogs along the coast, especially near the Kouchibouguac, the Kouchibouguacis, Aldouane, Richibucto, and in many other places. These bogs are often deep, and produce abundant crops of cranberries. In the interior, large bogs often occur upon the flat, undrained portions of the district, but they are usually shallow, and in many cases support a scrubby growth of hacmatac and black spruce. No use has yet been made of peat in this part of the country."

## COPPER.

**Production.** .s in former years the copper product of the year is represented in shipments of sulphuret ores from the mines of the Eastern Town- )s of Quebec and those of the copper-nickel ores from Sudbury.

'he characteristics of the latter deposits are given later in this report er the head of nickel.

**Quebec.** 'he chief contributors from the Quebec district were the Albert and wn Mines at Capelton, operated, as formerly, by Messrs. G. H. hols & Co., and the Eustis Mining Co., respectively, and the Moulton l and Howard Mines, operated by Mr. E. R. Howard. Messrs. G. H. hols & Co. have lately started operations at the old Huntingdon ıe, on lot 8, range viii, of Bolton. The others are all situated within ,dius of six miles of the town of Sherbrooke, in areas of Pre-Cam- ın chloritic, micaceous and talcose schists. The Howard Mine is close he contact of these, with the Cambrian rocks to the north-west.

'he workings are on the veins running parallel with the strike of the ;sts or perhaps rather on belts of the same, impregnated with copper iron sulphurets. These are of considerable width, in places being . to occasionally attain a thickness of as much as 50 feet in some of workings of the Capelton Mines, where they have been followed to a th of over 1,500 feet.

'he ores average about four per cent of copper, the percentage of )hur ranging between 35 and 45 per cent, whilst they also contain a le silver, averaging probably about 4 ounces per ton.

ıt the Albert Mines Messrs. G. H. Nichols & Co. have very extensive ı well equipped works for the utilisation of part of their ore in the nufacture of sulphuric acid, the "fines" being used for this purpose, ilst the higher grade ore is shipped direct to their other works at ırel Hill, New York, and similarly treated. At the Capelton works, ı is a Herreshoff water jacket furnace intended to bring the "cinder" ıaining after burning off the sulphur from the ore, to the state of atte." The great bulk of the ore from the other mines was shipped to acid-makers in the United States, although a small proportion burned and reduced to the state of matte and thus shipped by the tis Mining Company.

**British Columbia.** 'he amount of copper contained in the mixed silver, lead and copper he mines of southern British Columbia could not be ascertained as, official returns give only the total value of the ores for both the per and silver contents. This, however, does not amount to quite ,000 and as the greatest value of that lies in the silver, the amount of per thus overlooked cannot be very considerable.

Nova Scotia.

No contribution has been made to the grand total by the province of Nova Scotia this year, the activity in this direction being confined to development work and some little prospecting, of which the Report of the Department of Mines of the province speaks as follows:—

"Some attention has been given to the copper ores of Brierly Brook and Pinkietown, Antigonish county, and a lease has been taken at the former place by Mr. John Grant.

"A good deal of work was performed at the Coxheath Mines, Cape Breton county, and but for the general financial depression, systematic works would have been started last fall. The No. 2 shaft was sunk to the 250 feet level, and a cross cut was driven 134 feet to the north cutting the main, or B. vein, which was found to be 32 feet wide, and to yield a considerable proportion of smelting ore assaying from 10 per cent to 20 per cent copper, with a little silver and gold. On the new vein lying south of the present workings a shaft has been sunk 50 feet in paying ore, and on the surface it has been traced 1,000 feet. No. 1 shaft was unwatered and repaired, and the drill plant prepared, so that a drift would be run into vein B, lying a short distance to the south. The additional drills and compressors alluded to in a previous report have been added to the plant. giving it a strength of ten drills, with two in reserve; and some 3,000 feet of piping has been laid to connect shafts 1 and 3 with the plant at shaft No. 2. On the Argyle area the westward extension of the veins has been further tested, and a point has been selected for a new shaft.

"Mr. J. P. Gragg makes the following return of labour performed during the year 1890:

| | | |
|---|---|---|
| Skilled labour, overground | 1,717 | days. |
| Unskilled do | 3,380 | do |
| Skilled labour, underground | 1,785 | do |
| Unskilled do | 1,598 | do |
| Teams and drivers | 323 | do |
| Coal teams | 360 | do |

Production.

"About 1,000 tons of ore were extracted and banked."

The total amount of copper contained in the ores shipped as bef mentioned from the two provinces of Ontario and Quebec was 6,013, lbs., which taken at 15 cents, the average market price of the metal the year, gives a valuation of $902,050.

The production last year was given at 6,809,752 lbs., so that this y shows, on comparison, a falling off of 796,081 lbs.

Prices.

Table A shows the fluctuations in the price of the metal for the y as quoted for the three chief brands in the New York market and spe for itself.

Exports.

Imports.

exports and imports are given in Tables 1, 2 and 3.

COPPER.

TABLE 1.

EXPORTS.

Exports.

| Year. | Ontario. | Quebec. | Total. |
|---|---|---|---|
| 1885 | ..... | $262,600 | $262,600 |
| 1886 | $16,404 | 232,855 | 249,259 |
| 1887 | 3,416 | 134,550 | 137,966 |
| 1888 | ..... | 257,260 | 257,260 |
| 1889 | ..... | 168,457 | 168,457 |
| 1890 | 2,219 | 396,278 | 398,497 |

COPPER.

TABLE 2.

IMPORTS: PIGS, OLD AND SCRAP.

Imports.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880 | 31,900 | $ 2,130 |
| 1881 | 9,800 | 1,157 |
| 1882 | 20,200 | 1,984 |
| 1883 | 124,500 | 20,273 |
| 1884 | 40,200 | 3,180 |
| 1885 | 28,600 | 2,016 |
| 1886 | 82,000 | 6,969 |
| 1887 | 40,100 | 2,507 |
| 1888 | 32,300 | 2,322 |
| 1889 | 32,300 | 3,288 |
| 1890 | 112,200 | 11,521 |

COPPER.

TABLE 3.

IMPORTS: MANUFACTURES.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $123,061 |
| 1881 | 159,163 |
| 1882 | 220,235 |
| 1883 | 247,141 |
| 1884 | 134,534 |
| 1885 | 181,469 |
| 1886 | 219,420 |
| 1887 | 325,365 |
| 1888 | 303,459 |
| 1889 | 402,216 |
| 1890 | 472,668 |

Nova Scotia

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Prices.

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### COPPER.

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Discovery and exploration.

Besides the activity in the chief producing districts already m a small amount of exploratory work has been done on the Keweenian rocks of the north shore of Lake Superior, the g parallels of the native copper-bearing formations of the south which are situated the famous Calumet and Hecla, Tamarack a similar mines.

Ontario.

This work was prosecuted on the Michipicoten Island and M areas. At the latter point, the Silver Islet Mining and Land C had an exploratory party at work further examining the m veins and copper-bearing belts proved by former explorations there.

Copper has been known to occur throughout these are the earliest times, and numerous attempts have been made to them, which, for various reasons, have not met with succes copper exists in the native form impregnating the beds of t rocks and also exists thus in one of the accompanying aggl beds on Michipicoten Island. It also occurs native in fissur cutting the formation, as well as in the form of various sulph similar veins. The occurrence of argentiferous copper glan special feature of this formation, although so far the veins carry class of ore have never proved very persistent.

The other areas of these native copper-bearing rocks in C territory are to be found in St. Ignace and other islands in the n Nipigon Bay, L.S., and also the newly-discovered area in the to of Blake and Crooks, south of Port Arthur, mentioned in las report.

Further details relating to the various copper districts of the D will be found in the annual reports of the Geological Survey Depa the British Columbia districts being dealt with by Dr. Dawson R, Annual Report, 1887, and Part B, Annual Report, Vol. IV, 1 whilst the Quebec areas are well described by Dr. Ells in Part K, Report, Vol. IV, and in a report recently issued by Mr. Obal Government Mining Engineer of the province.

## GOLD.

Production.

As formerly, British Columbia and Nova Scotia are the main butors to the total production of this metal, the remainder furnished by the districts of Beauce in Quebec, the Saskatchewa washings and an estimated yield from the Yukon district.

The total yield thus obtained amounted to 64,046 ounces, $1,149,776, which, compared with last year, shows a falling off o

D
es

O:

F

ounces and $145,383. This is mainly due to the lesser yield of British Columbia and Nova Scotia, which show deficits, respectively, of $94,487 and $350,039. Regarding the first item it may be said to be due partly to the absence of returns from the Cassiar district and to the continuation of the cause similarly acting for some years, viz., the gradual working out of the placers and the slow development of the quartz-mining industry, which should eventually win back for the province its place as a gold producer.

Nova Scotia.

Of Nova Scotia the report of their Government Department of Mines speaks as follows:—

"The total returns for the year 1890 show that 41,886 tons of quartz were crushed, yielding 24,358 ounces of gold for 160,264 days' labour, compared with 26,155 ounces of gold from 39,160 tons of quartz for 211,548 days' labour. It is to be regretted that there is a falling off in the yield of gold, and no very satisfactory explanation can be offered. It is stated that recently mines have been started on insufficient evidence of permanent values in the veins, and that this past season their producing capabilities have diminished. It will be noticed that more quartz has been crushed, and it is in this direction, that of low grade ore, that the future extension of gold mining in Nova Scotia must be sought for."

The following table gives the yield by provinces:—

GOLD.

TABLE 1.

PRODUCTION BY PROVINCES.

| Provinces. | Ounces. | Value. | No. of Men. |
|---|---|---|---|
| Nova Scotia | 24,358 | $474,990 | 534 |
| Quebec | 75 | 1,350 | 25 |
| North-West Territories (including Yukon District) | 10,529 | 179,000 | 200 |
| British Columbia | 29,084 | 494,436 | 1,742 |
| | 64,046 | 1,149,776 | 2,501 |

The items for Quebec and the North-West Territories are close estimates, the latter including an approximation to the yield of the Yukon Territory in the absence of direct returns.

British Columbia.

Graphic Tables A, B and C, and Table 2, compiled chiefly from data furnished by the report of the Minister of Mines for that province, give the details of the industry and also the following figures of the value gold exported by the banks at Victoria during 1889 :—

| | |
|---|---|
| Bank of British Columbia....... .............. | $203,111 |
| Messrs. Gareschê, Green & Co................. | 183,587 |
| Bank of British North America............... | 25,331 |
| | $412,029 |

The total amount of gold produced by the province from 1858 to 18 inclusive, adds up to $55,192,163.

GOLD.

TABLE 2.

BRITISH COLUMBIA.

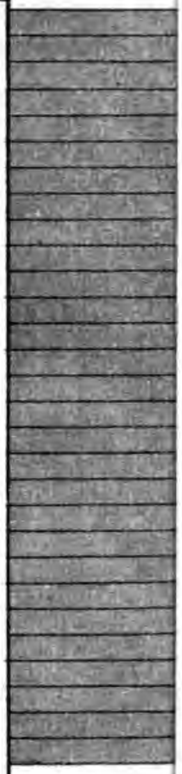
YIELD, ETC., BY DISTRICTS.

| District. | Divisions. | Whites. | Chinese. | Yield of Gold by Divisions. | Total Yie by Districts |
|---|---|---|---|---|---|
| Cariboo.... | Barkerville.......... | 74 | 156 | $61,200 | |
| | Lightning Creek..... | 27 | 123 | 38,000 | |
| | Quesnelle Mouth.... | 3 | 107 | 26,250 | |
| | Keithley Creek...... | 40 | 196 | 62,800 | |
| | | 144 | 582 | | $188,25 |
| Kootenay.... | Western... : ...... | 443 | 30 | 35,000 | |
| | Eastern ............ | 8 | 52 | 37,400 | |
| | | 451 | 82 | | 72,40 |
| Lillooet..... | ... ................. | 40 | 75 | 71,455 | 71,45 |
| Yale. .... | Hope, Yale and Lytton ............. | .......... | 150 | 9,000 | |
| | Osoyoos.......... .. | 71 | 29 | 17,000 | |
| | Similkameen.... ... | 39 | 79 | 23,450 | 49,450 |
| | | 110 | 258 | | $381,55 |
| | Total Whites...... | 745 | | | |
| | do Chinese...... | ..... . | 997 | | |
| | do employed.... | 1,742 | | | |

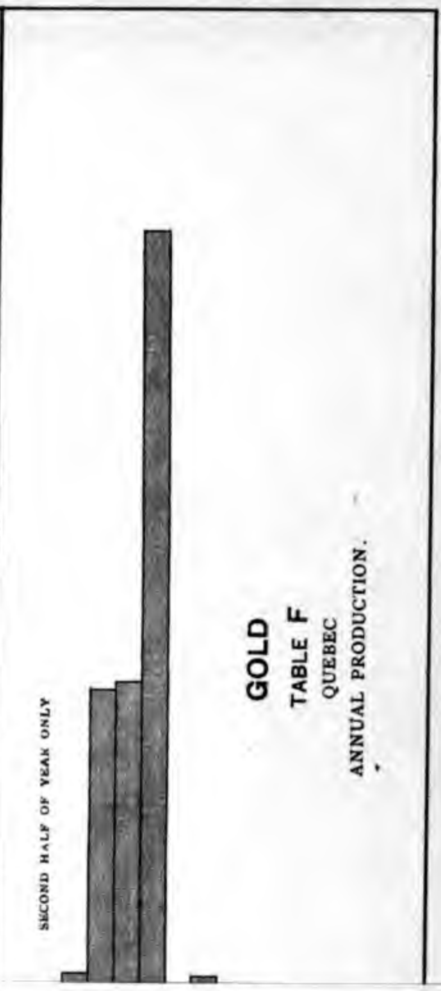
Nova Scotia. The details of the statistics regarding the gold mining industry i Nova Scotia, as given by the Government reports of that province wil be found in the below given tables, D and E and Nos. 3 and 4.

**Plate VII.**

| ar | Value |
|---|---|
| 2 | $141,871 |
| 3 | 272,448 |
| 4 | 390,349 |
| 5 | 496,357 |
| 6 | 491,491 |
| 7 | 532,563 |
| 8 | 400,555 |
| 9 | 348,427 |
| 0 | 387,392 |
| 1 | 374,972 |
| 2 | 255,349 |
| 3 | 231,122 |
| 4 | 178,244 |
| 5 | 218,629 |
| 6 | 233,585 |
| 7 | 329,205 |
| 8 | 245,253 |
| 9 | 268,328 |
| 0 | 257,823 |
| 1 | 209,755 |
| 2 | 275,090 |
| 3 | 301,207 |
| 4 | 313,554 |
| 5 | 432,971 |
| 6 | 455,564 |
| 7 | 413,631 |
| 8 | 436,939 |
| 9 | 510,022 |
| 0 | 474,990 |



| ar | Quantity |
|---|---|
| | TONS |
| 62 | 6,473 |



## GOLD

### TABLE F

QUEBEC

ANNUAL PRODUCTION.

## GOLD.

## TABLE 3.

## NOVA SCOTIA.

## DISTRICT DETAILS.

| Districts. | Number of Mines. | Days' Labour. | Mills. | Tons of Quartz Crushed | Yield of Gold per Ton. | | | Total Yield of Gold. | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Oz. | Dwt. | Gr. | Oz. | Dwt. | Gr. |
| field. | 1 | ........ | 1 | 2,500 | .. | 13 | .. | 1,643 | 5 | .. |
| u.. .. River | 3 | 17,748 | 5 | 6,661 | .. | 4 | 17 | 1,576 | 19 | 8 |
| n Mile Stream | 2 | 6,089 | 2 | 3,017 | .. | 15 | 6 | 2,305 | 2 | 18 |
| Catcha. | 1 | 4,333 | 1 | 1,008 | .. | 15 | 10 | 779 | 5 | .. |
| a. | 6 | 22,569 | 3 | 6,633 | .. | 11 | 19 | 3,883 | 12 | 12 |
| gu | 3 | 6,911 | 3 | 1,411 | 1 | 12 | .. | 2,263 | 1 | .. |
| n | 2 | 8,469 | 1 | 1,122 | 2 | 9 | 10 | 2,774 | 13 | 20 |
| on. | 1 | 6,657 | 2 | 1,892 | 1 | .. | .. | 1,899 | 15 | .. |
| ew | 2 | 3,778 | 2 | 760 | .. | 6 | 15 | 253 | 10 | 12 |
| n River | 1 | 19,408 | 1 | 6,415 | .. | 6 | 10 | 2,070 | .. | .. |
| ont. | 3 | 9,130 | 2 | 1,052 | .. | 11 | 17 | 616 | 15 | 12 |
| ke | 3 | 14,196 | 3 | 2,525 | .. | 12 | 18 | 1,612 | 2 | 13 |
| ley | 4 | 17,679 | 3 | 3,509 | .. | 2 | 18 | 482 | 12 | .. |
| burn | 1 | 11,787 | 2 | 960 | .. | 17 | 2 | 840 | 3 | 1 |
| claimed, etc | 5 | 11,410 | 5 | 3,284 | .. | 8 | 6 | 1,357 | 11 | 9 |
| | 38 | 160,164 | ... | 42,749 | .. | 11 | 9 | 24,358 | 9 | 9 |

## GOLD.

## TABLE 4.

## NOVA SCOTIA.

## PRODUCTION OF THE DIFFERENT DISTRICTS FROM 1862 TO 1890 INCLUSIVE.

| Districts. | Tons of Quartz Crushed. | Total Yield. | | | | Average yield per ton of 2,000 lbs. |
|---|---|---|---|---|---|---|
| | | Ozs. | Dwts. | Grs. | Value at $19.50 per oz | |
| u and Moose River | 43,959 | 23,818 | 11 | 13 | $ 464,462 | $10 56 |
| gue. | 16,192 | 32,581 | 11 | 16 | 635,341 | 39 24 |
| n. | 38,147 | 41,242 | 6 | 3 | 804,224 | 21 08 |
| w | 46,071 | 31,814 | 13 | 2 | 620,385 | 13 46 |
| ooke | 165,831 | 119,648 | 4 | 2 | 2,333,140 | 14 09 |
| ont | 22,236 | 23,240 | 14 | 5 | 453,192 | 20 36 |
| r | 29,122 | 19,126 | 15 | 18 | 372,970 | 12 80 |
| ke. | 37,353 | 21,850 | 17 | 4 | 426,092 | 11 41 |
| ley | 93,081 | 53,873 | 19 | 14 | 1,050,542 | 11 28 |
| River | 34,575 | 10,715 | 4 | 0 | 208,947 | 6 04 |
| ield. | 5,663 | 4,858 | 4 | 9 | 94,735 | 16 73 |
| burn. | 4,985 | 8,385 | 15 | 16 | 163,522 | 32 60 |
| Catcha. | 4,027 | 6,630 | 16 | 3 | 129,300 | 32 10 |
| on | 10,879 | 8,718 | 14 | 4 | 170,015 | 15 63 |
| Harbour | 39,975 | 27,940 | 17 | 1 | 544,845 | 13 63 |
| Hill | 39,909 | 18,715 | 19 | 19 | 364,962 | 9 14 |
| e Stream | 8,501 | 4,996 | 11 | 17 | 97,434 | 11 46 |
| a. | 11,021 | 7,859 | 16 | 1 | 153,265 | 13 90 |
| claimed, etc | 51,629 | 49,528 | 17 | 17 | 709,314 | 15 01 |
| als. | 703,156 | 506,548 | 9 | 20 | 9,877,687 | 14 03 |

If comparison is made between tables A and D it should be noted that the former would have to be enlarged five times to bring it to the same scale as the latter. The steady falling off of the yield of the placers of British Columbia is clearly brought out in this table and makes an interesting comparison with the fluctuations of the quartz-mining districts of Nova Scotia. Tables D and E also well illustrate the points already alluded to, viz., the falling off of the total yield, notwithstanding the increase of the number of tons of quartz crushed, thus showing that the ore milled was lower grade than usual.

Quebec.

Table F gives the yield of the metal by the Chaudière and Compton districts, Quebec, as far as ascertainable. The mining in these districts has been of late of a very desultory nature, so that it is difficult to get exact figures, but the falling off since its year of greatest prosperity in 1881 is very apparent.

The figures of the exports of the metal as found in the books of the Customs Department will be found in Table 5.

GOLD.

TABLE 5.

EXPORTS.

Exports.

| Provinces. | 1887. | 1888. | 1889. | 1890. |
|---|---|---|---|---|
| | $ | $ | $ | $ |
| Ontario | 6,650 | ........ | 2,660 | ...... |
| Nova Scotia | 321,379 | 163,412 | 191,671 | 304,521 |
| Manitoba | ........ | 50 | 261 | ...... |
| British Columbia | 592,300 | 464,696 | 414,658 | 402,271 |
| Totals | 920,329 | 628,158 | 609,250 | 706,792 |

There is no reason to believe that any gold ore is imported into the country and in any case its amount could not be ascertained, as the Customs Department makes no distinction between ore and bullion.

The details of the progress of the industry are as follows:—

Nova Scotia.

The gold of the province occurs in the area of Cambrian rocks forming the Atlantic slope of the peninsula of Nova Scotia, and extending from Canso on the north to Yarmouth on the south.

Nova Scotia.

he enclosing rocks consist of compact quartzites and sandstones ılly known as "whin," frequently felspathic, but rarely calcareous, ›ciated with argillaceous slates, in some instances magnesian or ›ritic.

'he veins occur along the denuded crests of anticlinal folds of the ta and carry free gold associated with varying amounts of sulphurets, ›nical pyrites, etc.

'he ore is stamped and amalgamated in the batteries, the tailings ning out over amalgamated copper plates.

'he following notes, reprinted from the Report of the Department of ıes of the province for 1890, give the main features of interest in the ıstry for the year:—

HALIFAX COUNTY.

*Montagu.*—Operations have progressed in this district during the past .r; the quartz averaging about as high as in the year 1889. Returns re received from the Annand, Kaye and Rose mills. The largest ld was 362 ounces from 120 tons crushed in the Annand mill.

*Caribou.*—The returns show 1,560 qunces from 6,591 tons, against 06 ounces from 7,338 tons in 1889. Returns were received from the kelode, Dixon, Touquay, Caffrey and the Moose River Gold Mining mpany mills. The returns from the Dixon mill show an average of ›r an ounce. Mr. Touquay crushed a large amount of surface ground l dump stuff.

*Waverley.*—The Lake View Mining Company, having completed their mill, commenced crushing in the fall. It is expected that they will dle in this mill a large amount of quartz, as extensive blocks of ore und have been won. A new company will operate the Gue and Wil- properties. A concentration and clorination plant has been put up e to treat ores, tailings, etc.

*Lake Catcha.*—The returns from this mine were good for the first t of the year, but there was little done during the fall.

*Fifteen Mile Stream.*—The operations of the New Egerton Company, ler Mr. Jas. A. Fraser, have been successfully carried on during the t year. The Stanley Company also worked steadily. The returns w 3,017 tons crushed, yielding 2,305 ounces, compared with 786 ıces from 1,416 tons in 1889.

*Salmon River.*—The approaching completion of the new and powerful l at this mine will enable an increased output to be maintained next ır. The returns show 6,415 tons crushed, and a yield of 2,070 ounces, ›raging 6 dwts., 10 grns., against 7,633 tons and 2,032 ounces during

Nova Scotia. the year 1889. The uniformity of the yield of large amounts of quartz in this mine is worthy of notice. Up to date this mine has yielded 35,270 ounces from 79,456 tons of quartz.

"At Killag crushing has commenced, the December returns of the Killag Company being 51 ounces from 45 tons. At other points in Halifax county there is little new to report.

"The Western Gold Mines were visited by Mr. Madden, Deputy Inspector, who reports that they are worked with proper regard to the safety of the men employed. I append a memo. of his visits:—

"The returns show—

| | Tons. | Ozs. | dwt. | Grs. |
|---|---|---|---|---|
| Brookfield | 2,500 | 1,643 | 5 | 0 |
| Malaga | 6,198 | 3,809 | 18 | 12 |
| Whiteburn | 960 | 840 | 0 | 0 |

### GUYSBORO' COUNTY.

"During the past season little has been done at *Goldenville* and *Wine Harbour*. At *Stormont* litigation has impeded mining, and the returns show a falling off. It is anticipated that this difficulty will be surmounted shortly, and it is to be hoped this district, one of the most promising in the province, will be worked to a greater extent than it has for several years.

"*Oldham.*—The returns show 2,774 ounces from 1,122 tons, compared with 2,709 ounces from 1,391 tons in 1889—the returns being from the Oldham Gold Mining Company. A noticeable yield was from June 23rd to June 30th, when 30 tons 8 cwt. yielded 875½ ounces. A new mill is being built by this company, and additions are being made by the Standard Company to their plant.

"*Rawdon.*—At the close of the year the returns showed 1,899 ounces from 1,892 tons of quartz, etc. A large amount of prospecting has been done in this locality, and at the end of the season it was anticipated that several valuable leads would be opened in the spring. Several lots of surface ground and slate were crushed by the Central Rawdon and the Gould-Northup mill, and yielded well. It is believed by some authorities that the surface is rich enough to be systematically treated.

"*Renfrew.*—Work has not been very successful in this district during the year 1890, the returns amounting to only 253 ounces. The Empress Gold Mining Company have restored their plant injured by fire last summer. Work on the free claim was to be closed at the end of the year.

Nova Scotia.

" *Uniacke.*—The principal returns were from South Uniacke. The ithrows continued working, and the new shaft on the Thompson pro-rty was sunk, striking the pay ground, which proved to be richer an to the westward.

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" *Memo. of visits paid by Mr. Madden, Deputy Inspector, to the Queen's County Mines.*

" *Brookfield Mine.*— * * * Thirty-eight men to work. his mine is in excellent order.

" *Malaga Mine.*— * * * North Lead working west; abbit Lead, is also being worked. The Chester Lead and Mill Lead e idle under repairs. The management is sinking No. 4, west shaft, nd when down about 90 feet more, will crosscut the other leads, and ill then have two years' work opened in advance. The Nugget and oulder workings are under repairs.

" *Boston Mining Company.*— * * * About fifty men nployed here erecting buildings and machinery. This mine has here-fore not been furnished with pump or engine, but having now obtained em, expect shortly to utilise them to advantage. The mine is in good der.

" *Caledonia Mine.*— * * * Thirty-six men employed. his year have erected a 10 stamp mill. The engine being connected ith the bank head of 5 or 6 shafts by a steel wire rope and a cog-and-nion-wheel at each bank head, connected with hoisting gear, are abled to hoist or lower from each shaft independently of the other. diamond drill is at work boring south at a point 100 feet down the aft testing the property. Two compressed air drills, capable of ring 4′ in 20 minutes, are at work in this mine; they have sufficient wer to start three or four more.

" *Parker Douglas Mine.*— * * * Forty men employed. even compressed air drills to work. Hoisting engine same system as aledonia. Six new hoists during the year. New machinery—boilers, 00 h. p.; boiler, 75 h. p., running the drills; a new rotary pump; fteen new stamps, making twenty in all; new boiler shed; new com-ressor house, 45′ x 32′; also a large addition to the mine house; new oncentrators. This company has prospected 30 leads bearing gold. hey have sunk 160′ in one shaft and cross-cut several other leads; laid ailroads on their lead and cross-cuts. The quartz is dropped down hoots into boxes, then taken to main shaft, where the boxes are hoisted nd then dumped into shoots carrying the quartz to the mill. This is robably the best equipped mine in the province, and it is in good rder.

Nova Scotia.

"*Newton Mine.*—Queen's Mining Company. * * * Busy erecting new machinery, the buildings for which are nearly completed.

"*West Mine*, so-called.— * * * Sixty men employed, chiefly engaged building. Also adding some new machinery.

"*Royal Gold Mining Company* for want of machinery are not doing very much, but have the necessary plant on the ground, and are hard at work getting into working shape.

* * * The mines are all being thoroughly repaired, and additions in the shape of the most modern machinery and appliances are being made to the plant.

Speaking of his work in Colchester county, Mr. Fletcher, of this Department, reports as follows of a district visited by him :—

"Great excitement was caused last summer by the reported discovery of gold in a whitish-grey flinty conglomerate consisting almost wholly of pebbles and grains of white quartz, beds of which underlie the Carboniferous limestone from the neighbourhood of Brookfield, far up the Stewiacke River on the north side. The region was proclaimed a gold district and rights of search taken out covering many miles. The attention of prospectors was, moreover, directed to all the conglomerates in the province. That the conglomerate of Gay's River is auriferious has long been well known, and Professor Hind has proved the existence of gold, silver and copper in certain beds of that nature near Baddeck. The Brookfield conglomerate was said to have given rich returns by milling, although a somewhat close examination by panning the dirt in the beds of the streams flowing over it failed to indicate the presence of gold in appreciable quantity. Two samples were sent to Mr. Hoffmann, one from the neighbourhood of the barytes mine, the other from the brook three hundred yards above the Glenbervie mills, but neither of them yielded, on assay, a trace of either silver or gold. Tests subsequently made on a large scale at the mill of one of the gold mines emphatically confirmed the accuracy of Mr. Hoffmann's assays."

Interest having been awakened in the gold regions of the southern end of the province, their further examination was decided upon, and Dr. Selwyn visited the district with Professor Bailey, with whom he arranged for the prosecution of the work. Speaking of his visit he says :—

"On the 17th of June I left Ottawa for Shelburne, Nova Scotia, to visit the gold fields first opened in 1886 at and near Caledonia Corner, and to investigate the probability of the same leads continuing southward and westward into the county of Shelburne, and also to ascertain what would be the best plan of operation in commencing a detailed

nination and survey of these western parts of Nova Scotia in con- Nova Scotia.
ion with the occurrence of gold, in quartz veins or in placer deposits,
regard to other economic minerals. I had, in 1870, visited and
orily examined the same part of the Nova Scotia coast, having then
e detailed notes on a journey from Digby *viâ* Weymouth, Cape St.
y and Salmon River to Yarmouth; and thence to Tuskett, Shel-
e, Liverpool and Bridgewater to Lunenburg, the Ovens and Chester,
rning to Bridgewater and Liverpool *viâ* New Ross and Dalhousie,
from Liverpool to Annapolis *viâ* Caledonia. The present trip has
led me to do little more than refresh my memory and to confirm
general accuracy of the conclusions then arrived at respecting the
ribution of the granitic and gneissic rocks and the gold bearing
es, as subsequently delineated on the geological map.

On the 23rd of June a trip was made 28 miles up the river from Shel-
ne to Indian Fields, where some pits have been sunk searching for
l. The country here is tolerably open, much of it flat and swampy
covered with drift and a fine granitic gravel or sand, with few
osures of the underlying rocks, though doubtless such would be found
following up the beds of all the brooks and small streams in the dis-
t. On the 24th of June I examined the route from Shelburne to
kport, and thence *viâ* Sable River, Port Joli and Granite River to
erpool. On the 25th I drove from Liverpool to Caledonia, 30 miles
nd, and found the rocks to be alternations of the " whin " and black
es of the Atlantic coast Gold Series or Lower Cambrian, as indicated
the published geological map. The gold field of Whiteburn, six
es south-west of Caledonia, was visited on the 26th. It is of limited
ent, on an oval shaped anticline outcrop of the lower " whin" rock,
rounded by the upper black slate. The veins are parallel with the
atification. They are not more than from six to nine inches thick,
l are therefore costly to work, as about four feet of hard, barren rock
to be mined in driving or sinking on them. Consequently,
ugh the quartz is of more than average richness the profits are not
ge. The beds dip about 45° to S.E. On the 27th I left Caledonia for
ar River, on the Annapolis Basin. As regards the extension or re-
rence of anticlines like those in which the Malaga and Whiteburn
ds occur, further to the south-west, no definite statement can be
de. That some such areas should be found in the unsettled country
ere the boundaries of the counties of Digby, Yarmouth, Shelburne,
en's and Annapolis meet, and especially along the flanks of the
tral granite mass, the limits of which have not yet been traced, but
ich certainly occupies a considerable area in this district and which
rossed, with a width of ten or twelve miles, on the road between
tland and Bear River, is most probable."

Nova Scotia.

Professor Bailey in his preliminary report to the Director, speaks of the district in these words:—

"About the 25th of July I proceeded, in accordance with your instructions, to the Province of Nova Scotia, and entered upon the study of the geology of Queen's and Shelburne counties. Having been desired by you to give my first attention to the coast, operations upon the latter were begun at the town of Liverpool, and were continuously carried on until the entire coast, from Port Medway harbour, forming the eastern boundary of Queen's county, to Pubnico harbour, forming the western limit of Shelburne, had been examined. This work was found to be unexpectedly easy, owing to the circumstance that almost the entire shore is occupied by fishermen, and bordered by roads which give easy access to any desired point. The comparative uniformity of the rock formations, consisting chiefly of fine grained gneisses, quartzites and mica schists, together with irregular masses of granite, further facilitated their study. The general result of these observations was to show that the crystalline rocks in question, which occupy a belt along the coast of from two to fifteen miles in width, are only a more highly altered condition of the gold-bearing slates and sandstones of the interior."

Quebec.

The gold region still remains under a cloud, and nothing has been done outside of a small amount of washing of the alluvial gravels of the tributaries of the Beauce River at and above the town of St. Francis.

There were only four parties working when the district was visited in September. On the Mill stream near the town of St. Francis, Messrs. McArthur & Coupal were at work, having sunk a shaft to bed rock at some little distance from the stream on its west bank. Some work was also done on the gravels of the Cumberland River under the direction of Captain Richards, whilst on the Famine River the St. Onge Bros. were tunnelling in on the level of the river in search of an old channel they believed to exist. Mr. Louis Gendreau was doing a little work, washing with a short sluice the gravels found at the confluence of the River du Loup and the Chaudière. All of these operations have only yielded a little gold, having been carried on only for short periods, and on a small scale. Besides this there have undoubtedly been small quantities washed out of the river bars by individual prospectors, of which it is evidently impossible to get any record. The water was, however, rather high for this latter class of work this season.

Outside of the Beauce district a small amount of work has been done on the streams of Compton county, chiefly in the township of Ditton.

A certain amount of interest is also being taken in the quartz veins of these districts which, there is reason to believe, might in some cases prove to be remunerative if properly examined and worked. Mr.

Obalski, the Provincial Government engineer, who has been studying this question, gives the following account of his investigations in the "Report of the Crown Lands Department of Quebec" for 1890: Quebec

"Quartz has been very little worked, although a good deal of attention has been awakened of late in the possibilities of the quartz mining industry. It has not been within my power in the time at my disposal to thoroughly investigate this area wherein occur so many quartz veins, but I have visited a certain number of them on which I picked some samples weighing from 3 to 5 pounds. Assays of the ore from these veins by Messrs. Ledoux & Co., of New York, show the presence of only a small proportion of gold, not over 30 cts. per ton. I may also state that having had several pieces from a quartz vein at Jersey Point pounded up and washed down in a pan, two fine particles of gold, unquestionably derived from the quartz, were obtained. Gold of similar character is also reported to have been obtained from a vein of the Famine river, in rear of St. George. These are by no means solitary instances of gold derived from the quartz veins in Beauce, many similar cases being reported from different quarters. We have contributed towards forwarding two tons of quartz from the Jersey vein to be tested by Mr. J. Thompson, South Uniacke (N.S.), in his experimental quartz mill, the latter gentleman having kindly volunteered to crush our quartz specimens. It is greatly to be desired that numerous assays from these veins should be made; and should these assays prove satisfactory and fair averages be given, the result would be highly conducive to the rapid development of this important industry.

"The results, as given by Mr. Thompson, are as follows:

"1. On a lot of 3,000 lbs., 5 dwt. and 18 gr. or 3 dwt. 14 gr. = $3.65 per ton of 2,000 lbs.

"2. On a lot of 800 lbs., 2 dwt. 18 gr. or 6 dwt. 21 gr. = $6.85 per ton.

"*Gold in the Laurentides.*—As already stated in previous reports, some prospecting in search of gold has been made throughout the Laurentian formation. In the county of Joliette, two new companies have been organized. One of these, the '*Compagnie minière du district de Joliette,*' operates lot IV, 6 of the gore of Kildare, near St. Alphonse; assays from a rock heavily charged with magnetic pyrites gave traces of the precious metal.

"The other company, styled: '*Compagnie des Mines d'or de Mattawin,*" is operating a mining property at a place called 'La Barrière,' in the unsurveyed portion of the township of Tracy. From the latter property several samples taken by myself on a small vein a few inches wide, Quebec.

were assayed by Messrs. Ledoux & Co., New York assayers, and while two of the samples gave traces of gold, a third one gave the following result:—

Gold, 1 ounce 83, per ton of 2,000 lbs.
Silver, 2 do 65, do

"From the various statements here presented, unquestionably worthy of interest and further investigation, no hasty conclusion should be drawn, it being very difficult, from the limited amount of work done, to express any decided opinion as to the auriferous character of this area."

Ontario.

A certain amount of exploration and discovery has been carried on in Ontario. In the Madoc district of Hastings county, the Crescent Gold Mining Company started work late in the fall, re-opening the Feigle mine.

On the north shore of Lake Huron discoveries of gold-bearing veins were reported, and some testing work done on the discoveries.

A small amount of similar work has been done at places on the north shore of Lake Superior, between Sault St Marie and Port Arthur.

Reports come to hand also of renewed interest in the Lake of the Woods district, where small gangs of men have been at work testing a number of the veins. Work has been proceeded with on the reduction works, which are in course of erection at Rat Portage, and which it is expected will shortly be completed. This should favourably affect the development of this promising district, so that it is hoped that we may have to report from thence a production of the metal next year.

North-West Territories.

Of the working for gold on the bars of the Saskatchewan River, Mr. Griesbach, Commandant N.-W.M.P. at Fort Saskatchewan, kindly furnishes the following information :—

"Mining on the river has not been carried on this year to the same extent it was last, owing to continued high water preventing the miners from getting at the 'pay dirt.' The amount of gold taken out of the North Saskatchewan River during the season from, say 50 miles above Edmonton and 50 miles below Fort Saskatchewan, is estimated at between $3,000 and $4,000."

British Columbia.

*Placer Mining.* Outside of the already mentioned falling off of the yield of gold from the alluvion and its causes there is nothing very new to relate.

An interesting discovery of an old river channel in the Cariboo District is described as follows by Mr. Bowron :—

"The Keithley Creek division of the district has proven most prolific, both as regards the season's output, as well as in the importance of its developments, the particulars of which will, no doubt, be fully reported by Mr. Stephenson; but as a discovery has been made in this division, which, I think, merits more than passing notice, a few words in addition to what may have been said on the subject will not here be out of place. British Columbia.

"The opinion has prevailed for many years among our most experienced miners from California and Australia that, judging from the formation of the country, there existed, and ultimately would be found, in this district immense obliterated river channels traversing the country upon a higher level than the present streams, which, in crossing the former, in many instances, received therefrom their chief supply of the precious metal. The first of such ancient river channels would now appear to have been discovered on the south side of the South Fork of the Quesnelle River. A Chinese company working up Dancing Bill's Creek, three miles above the Forks (*vide* Mr. Bowman's map), when about a thousand feet from the Quesnelle River, and at an altitude of one hundred and twenty-five feet above the stream, came to a pitch-off in the bed-rock which they were unable to follow, owing to the quantity of water encountered. They continued working ahead as near on a level as the grade to the sluices would allow. This occurred some ten or twelve years ago, and they have continued since that time to work into the hill without finding bed-rock. They use hydraulic pressure in working; but as their water supply is limited, and the face of their cut is now nearly two hundred feet in height, they make but small headway, but are known to have been taking out, with six men working, from five to eight thousand dollars annually. The operations of this company having for some years been watched with interest by the white miners in the vicinity, and the developments seeming to confirm their pre-conceived ideas of an immense 'blind' river channel in the hill, Messrs. Barker, Polley, Burrill & Co. sank two shafts half a mile above the Chinese Company, and back some fifteen hundred feet from the river, behind the rim rock which forms the river bank, and although not reaching bed-rock, owing to the quantity of water encountered, they found similar prospects to those obtained in the Chinese claim. Subsequently, Mr. John Hepburn, of Victoria, located ground below the Chinese, and in running in cuts developed similar pay gravel inside the rim rock, which is regarded as settling the question of a paying channel in the hill beyond a doubt. Messrs. Whittier & Pomeroy below, and the Champion Company above, have also located ground until there are nearly six miles of the channel claimed.

"Some are of the opinion that the channel will ultimately be traced to the Horsefly River, some twenty miles distant. However that may be, it is generally conceded that there must be at least ten miles of the old river bed. As to the richness of the pay, and consequent importance

5

British Columbia.

of the discovery, I can only say it is estimated that the Chinese Company are taking out at least one thousand dollars per lineal foot of the channel so far as they have worked, and as large river channels are usually very regular in the gold deposits, further comments are unnecessary."

Mr. Stephenson, writing from Quesnelle Forks, gives further particulars of the same discovery as follows:—

"The South Fork of Quesnelle River is at present very promising for hydraulic mining. The *Hop E. Tong*, a Chinese company, have for years been working on *Dancing Bill Gulch*, a small stream that empties into the left hand or south side of the South Fork, about three miles above the Forks. The gulch has cut across what is now proved to be an old channel, with a heavy rim rock between it and the present river. This old channel contains an immense deposit of gravel, which pays them well for hydraulic mining. Last year (1889) the *South Fork Hydraulic Mining Company* located and leased a piece of ground next above the Hop E. Tong Company, up the South Fork. They did some prospecting, sinking two shafts but did not get to the bottom of the channel. They got prospects in sinking those shafts that they considered warranted them in bringing water on to the ground. They have been engaged this season in making a trail to the claim, building a house and running ditch lines. They have located a ditch line fifteen and three-quarter miles long, and have commenced cutting a ditch four feet wide on the bottom, two feet deep, and six feet wide on top. This ditch they will push ahead a considerable distance next season, and will also place in position an hydraulic pipe about 450 feet long, suitable to handle the amount of water which the ditch will carry. Next below the Hop E. Tong, and joining their lower line, the *Victoria Hydraulic Mining Company* have located and leased a considerable piece of ground. This company, under the management of Mr. John Hepburn, with a gang of six to eight men, have been engaged in prospecting for the last three months. Mr. Hepburn tells me he has obtained satisfactory prospects for the work done. Then up the river and joining the South Fork Company, there has lately been another location made, and a company is about to be organized to prospect another section of the same channel."

Discoveries of auriferous gravel of more or less importance at various places in the province are alluded to in the above report, but otherwise the operations in alluvial gold are decreasing in importance.

*Quartz Mining.*—An increase in the interest taken in prospecting for veins continues to be apparent in most of the mining districts.

Speaking of the Cariboo district the report of the Minister of Mines for the province gives the following:—

British Columbia.

" Regarding the development in our quartz or mineral claims, although regret to say that there has not been that enterprise displayed we so uch desire, this season has not been entirely fruitless of results. The struction by fire of the Government Reduction Works last winter had most depressing effect upon this branch of our mining industry, but, rtunately, these works, although in operation but a few weeks, had oven their capability to successfully treat the character of ore found re, and consequently justified the Government in rebuilding the same on a somewhat increased capacity, which undertaking has been complished most succesfully under Mr. Martin's supervision, and the orks are now in operation again. It is a fact worthy of note that the oss product of the district has been increased by about $5,000 produced om the working of quartz. The Black Jack Quartz Mining Co. have, uring the season, prosecuted work on their mine; their shaft being now own to a depth of something over 100 feet, and exposing a valuable ody of ore. Their small prospecting mill was kept running a good art of the time until stopped by frost. This company has taken nother lot of sulphurets to the test works, which is now under treatent. A most satisfactory test of the ore from this mine was made at The Cassell Gold Extracting Co.'s Works." Glasgow, Scotland. From 60 pounds of ore sent a result of something over $80 per ton was btained; the ore worked up to 90 per cent. of the assay value. The dvantages of this company's method is that no roasting is required, and he company claim that in ordinary cases ore can be treated for oneourth the cost of working by the chlorinating process, a circumstance hich, if substantiated by further working tests, means wealth to this istrict.

" The Island Mountain Co. completed their ten-stamp mill, to which attached four concentrators and an improved rock crusher, and the achinery was put into operation about 20th August, and was found to ork satisfactorily. Rock crushing commenced on 25th August, and by 5th September several hundreds of tons were put through. Some diffiulty was experienced in getting the silver plates to catch the gold, wing to the presence of some foreign substance coating the plates, but fter a time this was partially remedied. Some fifteen or twenty tons f sulphurets were saved and brought to the Government Works for reatment. I learned from Mr. May, who put up the Island Mountain o.'s mill and superintended the working of the ore, that the test made annot be regarded as a fair result, inasmuch as the ore was taken from he dumps at the various tunnels belonging to the company, and was ostly surface rock, and only trial runs of each kind of rock."

British Columbia.

In the south-eastern part of the province, in the districts of East and West Kootenay and Yale, considerable activity has prevailed in prospecting for and opening up a number of veins. Some of these might be classed as gold veins proper. Most of the veins of this and other mining camps of these districts, however, are better classed as silver and copper deposits, although carrying more or less gold, some assays running very high in that metal. They will therefore be described in the article on silver. Some of the veins of the Toad Mountain camp, however, might properly be classed as gold veins, and of these Dr. Dawson speaks as follows :—

"*With the exception of the Poorman Mine and other adjacent claims on Eagle Creek, near the west end of Toad Mountain, all the metalliferous deposits so far found occur in the stratified rocks. The exceptional veins traverse a hard dark-grey mica-syenite, and differ in character from the other ores containing auriferous iron pyrites in a quartz gangue."

The following information relating to the year's development of these veins is given in the Report of the Government Gold Commission for the district :—

"The Poorman, on Eagle Creek, has been developed by shafts, tunnels and drifts for a depth of 125 feet and about 600 feet along the ledge. Stoping has been done from the 90 foot level. The stamp mill has not been worked during the whole of the summer, owing to the scarcity of water. Abont 1,200 tons of quartz has been crushed, the returns from which can only be conjectured, as the proprietors do not feel disposed to make them public. None of the sulphurets, which are rich, have yet been treated. The last clean-up produced a gold bar worth over $7,000. Two men are engaged in running a tunnel at the upper end of the mine, which will strike the ledge in about 450 feet, and will be extended 400 feet further to reach the ore deposit in the White-Buchanan mine, which runs parallel to the Poorman, and is owned by the same proprietors. To advance the work as rapidly as possible a Burleigh rock drill will be set up and operated on the opening of navigation.

"On Gold Hill, about 1½ miles south of the Poorman, are located the Wild Cat, Catamount and Forest mines. The first mentioned exhibits a large body of ore composed of quartz impregnated with sulphurets. A tunnel is now in a distance of 115 feet. The vein matter assays from $15 to $30, and is of a free milling character. The vein is 10 feet wide, and is in a formation of hornblende granite. One-half of the claim was bonded by H. Keefer, the railway contractor, for 30 days, which he has since obtained by payment of the amount mentioned in the agreement.

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* Annual Report Geogloical Survey Dept., Vol. IV, p. 33 B.

British Columbia.

"One mile below where the trail crosses Eagle Creek several promising locations exist, the principal of them being the Paradise, Total Wreck, Pioneer, High Ore, and Wizard. The Paradise has a tunnel 30 feet long, exposing a vein three feet wide carrying excellent ore. The Pioneer shows a body of mineral from 2½ to 6 feet wide. The High Ore has a number of open cuts and a prospect shaft, from which several tons of good-looking quartz has been extracted.

"The Royal Canadian has two tunnels, one a distance of 75 feet, the other 65 feet; width of vein from 2½ to 3 feet, existing in a slate country rock. The stated value of the ledge is said to be from $20 to $30 to the ton. Mr. Johnson, of Sydney, Australia, offered $15,000 for one-half the claim, and agreed to erect a plant to cost as much more, provided one ton of average ore would return $20 to the ton, at the sampling works, Revelstoke.

"On Rover Creek some locations have been made, which promise to become of great value. They are known as the Whitewater, Midas, Snow-water and Columbia. The tunnel in the first mentioned is 90 feet long, showing a ledge 6 feet wide, of a free milling nature. It is a contact vein, the hanging wall being granite and the footwall slate. The average of fifteen assays made amounted to $80 in gold. The return from 1½ tons tested at the sampling works was $110 in gold and $9 silver to the ton. Assays of similar richness were obtained from the Snowwater, which is an extension of the former. A trail has been graded a distance of ten miles, and it is the intention of Mr. Davys, who is one of the principal owners, to obtain the two Huntington mills, belonging to the Cottonwood Gold Mining Company, Toad Mountain, and work them to their fullest capacity.

"The output of ore from the gold belt, extending from Eagle to Rover, is estimated at about 1,800 tons, 1,200 tons of which were extracted from the Poorman, and the remainder the result of prospecting work in the various claims referred to. Of course this will be greatly increased when operations are confined to the production of ore only."

From Yale district, Kamloops division, comes the report that only assessment work has been done on the claims of that vicinity, that the Nicola Milling and Mining Company has suspended operations for the present, and that no new discoveries of veins have been made. From another part of the district however the following discovery is reported.

" *Siwash Creek.* Seven miles north-east from Yale, on which about 20 hardy and industrious miners have worked the entire season, many of them performing assessment work only, there has been found rich quartz carrying free gold.

British Columbia.

"The Roddick Company, I may state, have expended nearly $3,000 in opening their claim by driving tunnels and sinking, finding very rich deposits in free milling ore. Test assays have been made in the province and in California that range from $150 to $2,000 per ton in gold."

The mines of the Rock Creek camp received a certain amount of attention, but that district is kept back for want of communications.

"*Cherry Creek.*—Mr. L. W. Riske, in company with Mr. Donald McIntyre, have completed the erection of their quartz mill on the Monashee Mountain, and hope, after getting their ditch constructed, to convey the water a distance of two or two and a half miles to the mill, when they will at once commence crushing the ore, which is pronounced to be very rich."

Further news of this point is given in the following remarks made by Dr. Dawson :—*

"In the course of the preliminary work done on the Shuswap sheet, the Monashee Mine, situated on the watershed between Cherry Creek and Kettle River, and in process of development by Mr. D. McIntyre, was visited. There are at this place several distinct veins of auriferous quartz in which specks of free gold are frequently visible. These veins, in which points of gold are often visible, traverse Monashee Mountain, composed of quartzite, diabase (?) and limestone strata, near to the margin of a wide granitic mass, which lies to the south. Several small tunnels and openings have been made on the veins, and a small mill has been erected with a view to commencing work on the ore in the spring. A number of small specimens selected from the ore at the mouth of the principal working drift at this place, have proved on assay by Mr. Hoffman, to contain, gold 0·583 oz., silver 2·683 oz. to the ton."

## GRAPHITE.

Distribution.

The known deposits of this mineral in the country chiefly occur in the Laurentian rocks of the districts of the north shore of the Ottawa River in the Counties of Argenteuil and Ottawa, Province of Quebec, and in similar rocks in Eastern Ontario along the line of the Kingston and Pembroke Railway.

In both districts they mostly occur in the form of irregular veins, strings or beds in the crystalline limestones of the series or in scales disseminated throughout the same whilst a number of interesting minerals form their associates, notably pyroxene, wollastonite, felspar, quartz, sphene, phlogopite, zircon, idocrase, etc.

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*Summary Report Geological Survey Department for 1890.

Mining has also been carried on in the Laurentian rocks of the immediate vicinity of St. John, New Brunswick. Here graphite in a finely divided state is disseminated through the rock and at a few points is found in beds of economic importance. They occur in argillites and sub-crystalline limestones and vary from one to four feet in thickness.

Operations.

At the Walker Mine in Buckingham township, Ottawa county, which was working last year, operations were suspended at the end of February, pending negotiations for the more extended capitalization of the mine.

At this place the graphite is found in the gneissic rocks, showing two modes of occurrence. At places on the property it occurs disseminated through the rock, whilst at others the foliated and columnar varieties occur forming a solid filling in veins traversing the formation. The veins are of varying widths, from a few inches up to 2 feet and the surrounding gneiss has a generally rusty and rotten appearance,

Comparison with foreign graphite.

Allusions to the mode of occurrence of the mineral at the various known localities will be found at various places in the Reports of the Geological Survey and analyses and comparisons of its qualities with those of other countries in "Report on Canadian Graphite" by Mr. Hoffmann, Chemist to the Survey; Report of Progress, Geological Survey, pp. 489–512, 1876-77.

In this pamphlet investigation was made of the specific gravity of a number of Canadian specimens, the percentage of ash, and its composition being also determined on all of which points comparison was made with samples of graphite from New York State and from Ceylon. Experiments were also carried out to determine their relative combustibility with a view, amongst other things, to illustrate the fitness of the home product for the manufacture of crucibles.

The results of the investigation show that as regards ash the Canadian graphite gave more than the Ceylon, but much less than the New York. Speaking of the above mentioned experiments and those on the relative combustibility of the different samples examined the report says:—

"From these experiments it will be seen that in respect to incombustibility the Canadian graphite may claim perfect equality with that of Ceylon; and that consequently—apart from any consideration of the proportion and nature of the associated foreign matter—it is in no wise inferior to the latter as a material for the manufacture of crucibles.

"Prepared according to the present process, the 'dressed graphite' (analyses 5 to 14 inc.) obtained from the beds of the disseminated mineral (analyses 1 and 3) is apt to contain more or less carbonate of lime and oxide of iron; it has however been pointed out, experimentally, (analyses 12 and 14) how readily these admit of removal by a very simple and inexpensive chemical treatment, leaving the graphite with a very small amount of ash, and that of a nature in no wise prejudicial to its application for the purpose here under consideration. That the graphite from this source, in itself compares favourably with that of Ceylon, will be seen from the above table, 1 and 3."

**Methods of preparation.**

The plumbago obtained at St. John, N.B., only goes through a simple process of hand picking before being shipped, but at the chief mine of the Ottawa county district works have been erected to crush, wash and otherwise prepare the material.

Here, after passing through a Blake crusher, the rock passes through two batteries of Cornish stamps of 10 heads each. From thence it is carried by water to the buddle floor where there are 6 large circular buddles besides two for finishing. These buddles have fine sieves in the outlets and the separation takes place by the settling of the graphite, which is the lighter material, out towards the circumference, whilst the rocky impurities remain near the centre. The waste water from these passes to catch pits where a further amount of the finer graphite is caught. After passing through the buddles the material goes to a drying furnace and the purer portions are further ground and bolted to produce the best grades.

This mill is capable of handling about 40 tons per day of 24 hours.

During the time of the recent operations, which ceased in February last, only the rock containing disseminated graphite was being mined and treated, carrying, it is said, from 25 to 30 per cent of graphite.

At this place the grades made are as follows:—

| Grade. | Uses. | Value. |
|---|---|---|
| A. 0 | Pencil manufacture and electro-typing | 50 to 75 cts. per lb. |
| A. 1<br>A. 2 | do do fine lubricate | 4 to 25 do |
| A. 3<br>A. 4 | Lubricate and shot polishing | |
| A. 5<br>A. 6 | Crucible manufacture | |
| S. P. | Slime products for stove polish manufacture | 3 to 6 do |
| F. F. | Foundry facings | 1½ cts. per lb. |

Latterly a very interesting application has been made by the Ontario Bolt Company of the rock containing the disseminated plumbago in finishing off and facing a certain grade of small and plain castings. They have found it a greatly improved substitute for the grade of plumbago formerly used for this purpose as when the castings are rotated with it in the "rumblers" the hardness of the rock helps to wear down their roughnesses whilst the plumbago contained in it gives their surface the necessary polish.

Production.

The production for the year amounted to 175 tons, valued at $5,200, against 242 tons and $3,160 for last year. This falling off in the amount, but increase in the value, is due to the fact that one of the chief operators whilst working only a short time made sales of a higher grade article.

Exports and imports.

The exports and imports are given below in Tables 1, 2 and 3.

GRAPHITE.

TABLE 1.

EXPORTS.

| Year. | New Brunswick. | | Ontario. | |
|---|---|---|---|---|
| | Cwts. | Value. | Cwts. | Value. |
| 1886 | 8,142 | $3,586 | | |
| 1887 | 6,294 | 3,017 | | |
| 1888 | 2,700 | 1,080 | | |
| 1889 | 660 | 422 | 22 | $116 |
| 1890 | 400 | 160 | 329 | 1,369 |

GRAPHITE.

TABLE 3.

IMPORTS OF BLACKLEAD.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $18,055 |
| 1881 | 26,544 |
| 1882 | 25,132 |
| 1883 | 21,151 |
| 1884 | 24,002 |
| 1885 | 24,487 |
| 1886 | 23,211 |
| 1887 | 25,766 |
| 1888 | 7,824 |
| 1889 | 11,852 |
| 1890 | 10,276 |

Of the deposits, Mr. J. B. Tyrrell, in an article entitled "Gypsum deposits in Northern Manitoba," published in the *Canadian Record of Science*, April, 1889, writes :—

"In the north-west corner of township 32, range VIII, west of the principal meridian, is a rounded hill rising thirty-five feet above the plain, its greatest length being about 600 feet, and its greatest breadth 150 feet. Its surface is overgrown with small canoe-birch. Two holes, each about eight feet deep, have been dug by prospectors in this hill. One at the top shows, below a foot of decomposed material, seven feet of hard, compact, white anhydrite or 'bull plaster,' exhibiting a more or less nodular structure, and breaking on the surface into small irregular fragments. Very little bedding can be detected in the mass. The other hole is in the side of the hill fifteen feet lower down, and shows on top two feet and a half of white clay, consisting of decomposed anhydrite, below which is five feet and a half of white nodular anhydrite similar to that in the other hole. This gives a thickness, almost certainly, of twenty-two feet of this rock, and it is not improbable that the hill is composed entirely of it.

"Again, just north of the ninth base line, and two miles east of the township corner, between ranges VIII and IX, is a poplar-covered hill or ridge, thirty feet high. In various places on this hill are exposures of snow-white gypsum, similar to what has been described above, showing in some cases a thickness of ten feet in one section. The most of it is massive or crypto-crystalline, and lies in regular beds which dip slightly towards the west."

Production.

The total quantity produced in the Dominion during 1890 was 226,509 tons, valued at $94,033, the output by provinces being :—

GYPSUM.

TABLE 1.

PRODUCTION BY PROVINCES.

| Provinces. | Tons. | Value. |
|---|---|---|
| Nova Scotia | 181,285 | $154,972 |
| New Brunswick | 39,024 | 30,986 |
| Ontario | 6,200 | 8,075 |
| | 226,509 | $194,033 |

he production for the past five years has been :—

| | | | |
|---|---|---|---|
| 1886.......... ... ...... .... | 162,000 tons, | valued at | $178,742 |
| 1887 .... ............ .... | 154,008 " | " | 157,277 |
| 1888...... .... ... .......... | 175,887 " | " | 179,393 |
| 1889.. .... .. ... ... .......... | 213,273 " | " | 205,108 |
| 1890 .. ....... ................ | 226,509 " | " | 194,033 |

f this production the greater part was exported in the crude state, rly all of the production of Nova Scotia being shipped as such, while New Brunswick and Ontario small quantities of plaster of Paris were nufactured as well as land plaster, which was sold locally.

Manufactures.

he amount of gypsum ground and sold as land plaster was 5,550 s, valued at $18,114, and of plaster of Paris 19,460 tons, valued at ,880. In the manufacture of plaster of Paris there is a loss in weight material of about 20 per cent. Assuming that such be the case there re therefore 24,325 tons of gypsum used in the production of 19,460 s of plaster of Paris, a total quantity manufactured in Canada of 375 tons, or a little more than one-tenth of the total output.

esides the foregoing, a quantity of "Alabastine" and "Plastico" was de by the Alabastine Company of Paris, Ont., and a considerable ntity of superior quality rock was shipped by the Albert Manufacing Company of Hillsboro', N.B., to their works at Newark, N.J., for manufacture of "terra alba."

he exports of crude gypsum are given below:—

Exports.

GYPSUM.

TABLE 2.

EXPORTS OF CRUDE GYPSUM.

| ARS. | ONTARIO. | | NOVA SCOTIA. | | NEW BRUNSWICK. | | TOTAL. | |
|---|---|---|---|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. | Tons. | Value. | Tons. | Value. |
| 4.. | ...... | ...... | 67,830 | $ 68,164 | ...... | ...... | 67,830 | $ 68,164 |
| 5.. | ...... | ... | 86,065 | 86,193 | 5,420 | $ 5,420 | 91,485 | 91,613 |
| 6.. | 120 | $ 180 | 87,720 | 87,590 | 4,925 | 6,616 | 92,765 | 94,386 |
| 7.. | ...... | ...... | 106,950 | 93,867 | 5,030 | 5,030 | 111,980 | 98,897 |
| 8.. | 489 | 675 | 88,631 | 76,695 | 16,335 | 16,435 | 105,455 | 93,805 |
| 9.. | 579 | 720 | 95,623 | 71,353 | 8,791 | 8,791 | 104,993 | 80,864 |
| 0.. | 875 | 1,240 | 125,685 | 111,833 | 10,375 | 10,987 | 136,935 | 124,060 |
| 1.. | 657 | 1,040 | 110,303 | 100,284 | 10,310 | 15,025 | 121,270 | 116,349 |
| 2.. | 1,249 | 1,946 | 133,426 | 121,070 | 15,597 | 24,581 | 150,272 | 147,597 |
| 3.. | 462 | 837 | 145,448 | 132,834 | 20,242 | 35,557 | 166,152 | 169,228 |
| 4.. | 688 | 1,254 | 107,653 | 100,446 | 21,800 | 32,751 | 130,141 | 134,451 |
| 5.. | 525 | 787 | 81,887 | 77,898 | 15,140 | 27,730 | 97,552 | 106,415 |
| 6.. | 350 | 538 | 118,985 | 114,116 | 23,498 | 40,559 | 142,833 | 155,213 |
| 7.. | 225 | 337 | 112,557 | 106,910 | 19,942 | 39,295 | 132,724 | 146,542 |
| 8.. | 670 | 910 | 124,818 | 120,429 | 20 | 50 | 125,508 | 121,389 |
| 9.. | 483 | 692 | 146,204 | 142,850 | 31,495 | 50,862 | 178,182 | 194,404 |
| 0.. | 205 | 256 | 145,452 | 139,707 | 30,034 | 52,291 | 175,691 | 192,254 |

Ground gypsum, to the value of $105, was exported from the provin of New Brunswick during 1890.

Imports.

The imports of gypsum crude, ground, and calcined, or plaster Paris, are given in the three following tables:—

### GYPSUM.

### TABLE 3.

### IMPORTS OF CRUDE GYPSUM.

| Fiscal Year. | Tons. | Value. |
|---|---|---|
| 1880 | 1,854 | $3,203 |
| 1881 | 1,731 | 3,442 |
| 1882 | 2,132 | 3,761 |
| 1883 | 1,384 | 3,001 |
| 1884 | .... | 3,416 |
| 1885 | 1,353 | 2,354 |
| 1886 | 1,870 | 2,429 |
| 1887 | 1,557 | 2,492 |
| 1888 | 1,236 | 2,193 |
| 1889 | 1,360 | 2,472 |
| 1890 | 1,050 | 1,928 |

### GYPSUM.

### TABLE 4.

### IMPORTS OF GROUND GYPSUM.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880 | 1,606,578 | $ 5,948 |
| 1881 | 1,544,714 | 4,676 |
| 1882 | 759,460 | 2,576 |
| 1883 | 1,017,905 | 2,579 |
| 1884 | 687,432 | 1,936 |
| 1885 | 461,400 | 1,177 |
| 1886 | 224,119 | 675 |
| 1887 | 13,266 | 73 |
| 1888 | 106,068 | 558 |
| 1889 | 74,390 | 372 |
| 1890 | 434,400 | 2,136 |

| ar | Province | Quantity | Value |
|---|---|---|---|
| | | TONS | $ |
| 1886 | B. C. | 3,941 | 7,88 |
| | ONT. | 16,032 | 32,06 |
| | QUE. | ....... | ...... |
| | N. S. | 49,735 | 87,03 |
| 1887 | B. C. | 2,796 | 6,99 |
| | ONT. | 16,598 | 36,21 |
| | QUE. | 13,404 | 26,80 |
| | N. S. | 43,532 | 76,18 |
| 1888 | B. C. | 8,372 | 14,95 |
| | ONT. | 16,894 | 37,71 |
| | QUE. | 10,710 | 74,50 |
| | N. S. | 42,611 | 74,50 |
| 1889 | B. C. | 15,487 | 20,74 |
| | ONT. | ........ | ...... |
| | QUE. | 14.533 | 33,09 |
| | N. S. | 54.161 | 97,80 |
| 1890 | B. C. | ........ | ...... |
| | ONT. | 5,000 | 12,50 |
| | QUE. | 22,305 | 41,19 |
| | N. S. | 49,206 | 101,68 |

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GYPSUM.

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| 1884 | ..... .... | 3,416 |
| 1885 | 1,353 | 2,354 |
| 1886 | 1,870 | 2,429 |
| 1887 | 1,557 | 2,492 |
| 1888 | 1,236 | 2,193 |
| 1889 | 1,360 | 2,472 |
| 1890 | 1,050 | 1,928 |

GYPSUM.

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| 1890 | 434,400 | 2,136 |

| Province | Quantity | Value |
|---|---|---|
| | TONS | $ |
| B. C. | 3,941 | 7,88 |
| ONT. | 16,032 | 32,06 |
| QUE. | ....... | ...... |
| N. S. | 49,735 | 87,03 |
| B. C. | 2,796 | 6,99 |
| ONT. | 16,598 | 36,21 |
| QUE. | 13,404 | 26,80 |
| N. S. | 43,532 | 76,18 |
| B. C. | 8,372 | 14.95 |
| ONT. | 16,894 | 37.71 |
| QUE. | 10,710 | 74,50 |
| N. S. | 42,611 | 74.50 |
| B. C. | 15,487 | 20,74 |
| ONT. | ........ | ...... |
| QUE. | 14.533 | 33,09 |
| N. S. | 54.101 | 97,80 |
| B. C. | ........ | ...... |
| ONT. | 5,000 | 12,50 |
| QUE. | 22,305 | 41,19 |
| N. S. | 49,206 | 101,68 |

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R. D. INGALL

### GYPSUM.

### TABLE 5.

### IMPORTS OF PLASTER OF PARIS.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880 | 667,676 | $ 2,376 |
| 1881 | 574,006 | 2,864 |
| 1882 | 751,147 | 4,184 |
| 1883 | 1,448,650 | 7,867 |
| 1884 | 782,920 | 5,226 |
| 1885 | 689,521 | 4,809 |
| 1886 | 820,273 | 5,463 |
| 1887 | 594,146 | 4,342 |
| 1888 | 942,338 | 6,662 |
| 1889 | 1,173,996 | 8,513 |
| 1890 | 693,435 | 6,004 |

## IRON.

**Production.**

n ore, 76,511 tons were produced in Canada during the year
lued at $155,380, showing, compared with 1889, a decrease
ity of 7,670 tons and an increase in value of $3,740, the latter
tributable to the fact that the ores of Nova Scotia brought a
gher price this year than last. The decrease in quantity may
ly accounted for by the cessation of operations by the Puget
on Company, of British Columbia, who were operating in 1889.
duction by provinces is shown comparatively with that of
years in the graphic table A.

annual production of iron ore in Nova Scotia the following
vill afford ample explanation :—

### IRON.

### TABLE 1.

### NOVA SCOTIA : ANNUAL PRODUCTION OF ORE.

| | Tons. |
|---|---|
| 1876 | 15,274 |
| 1877 | 16,879 |
| 1878 | 36,600 |
| 1879 | 29,889 |
| 1880 | 51,193 |
| 1881 | 39,843 |
| 1882 | 42,135 |
| 1883 | 52,410 |
| 1884 | 54,885 |
| 1885 | 48,129 |
| 1886 | 44,388 |
| 1887 | 43,532 |
| 1888 | 42,611 |
| 1889 | 54,161 |
| 1890 | 49,206 |

Imports and exports.

No ore was imported into Canada during the year, the only trade statistics available, therefore, are those of exports which are shown in table 2 as follows :—

IRON.

TABLE 2.

EXPORTS OF ORE.

| Province. | 1887. | | 1888. | | 1889. | | 1890. | |
|---|---|---|---|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. | Tons. | Value. | Tons. | Value. |
| Ontario ........ | 12,244 | $38,990 | 31,161 | $36,397 | 4,108 | $10,407 | 18,601 | $38,967 |
| Quebec.......... | 38 | 119 | 10 | 380 | ........ | 2,700 | 120 | 1,640 |
| Nova Scotia.. . | ........ | ........ | ........ | .. ... | ........ | 100 | ........ | ........ |
| British Columbia. | 1,410 | 3,525 | 7,300 | 18,400 | 13,335 | 26,680 | 33 | 83 |
| Totals.. . ... | 13,692 | 42,634 | | 55,177 | | 39,887 | 18,754 | 40,690 |

Developments Nova Scotia.

In Nova Scotia operations were carried on by the Londonderry Iron Company and the New Glasgow Iron, Coal and Railway Company, the latter company as yet only doing development work, while the former are carrying on the business established for many years at Londonderry. Of the iron industry in Nova Scotia Mr. E. Gilpin, jr., Inspector of Mines for that province, writes thus in his report for the year 1890:—

"Operations have been steadily pursued by the Londonderry Iron Company, both at their mines and their furnaces. Calcining furnaces have been built, and large amounts of spathic ore have been burned. This process greatly increases the percentage of iron in the ore, and makes it more fusible.

"The New Glasgow Iron, Coal and Railway Company have commenced a branch line from Eureka to connect with their furnace at the forks of the East River, and with their mines at Springville. They have continued opening and testing their large and valuable properties.

"Iron ore was mined by this Company at Brookfield. Mr. Leckie, of Londonderry, tested a promising deposit near Pugwash, and discoveries were reported from various localities."

New Brunswick.

No iron ore was mined in New Brunswick during the year. A little work in development was, however, done on a property on the Millstream River, Gloucester county, where according to one of the owners, Mr. John Ellis, of Bathurst, N.B., three cross-cuts had been de during the year upon a deposit of magnetite. In conversation, r. Ellis stated that the vein was 32 feet in width, striking E. and W. d dipping nearly vertically, and had been traced for upwards of one le and a half. According to an assay by Prof. J. T. Donald, of Mon- al, the ore contains,—

| | | |
|---|---|---|
| Metallic iron | 65·85 | per cent. |
| Silica and insoluble matter | 8·10 | do |
| Phosphorus | 0·01 | do |
| Sulphur | 0·17 | do |

It is understood that a small quantity of ore was taken out in proving e vein, though no shipments have been made.

**Quebec.** In the province of Quebec active operations were carried on at the adnor and Drummondville furnaces and at the Bristol mines on lot 21, nge II, Bristol township, county of Pontiac.

These furnaces have been in operation for many years and are pplied by bog ore procured in their vicinity; that used at the Radnor rnace being in a large measure dredged from the bottom of Lac à la rtue. A change in proprietorship is reported from Radnor during e past year, the furnace having passed into the hands of the Canada Iron rnace Company, Limited, of Montreal, remaining, however, under the perintendence of the late owner, Mr. George McDougall, of Three vers. It is the intention of the present owners to increase the capacity the works by the erection of a new furnace about 45 feet in height, th a 10-feet bosh, having a capacity of about fourteen tons per day, king that of their works about twenty tons per day.

**Ontario.** In eastern Ontario but little work was done during the year, the small ount shipped being altogether from the district served by the King- n and Pembroke Railway Company.

In western Ontario, although no active operations were carried on, ere have been further discoveries made of very extensive deposits of h grade ore in the regions west and north-west of Port Arthur in goma District, the more important being undoubtedly those in the ighbourhood of the Atikokan River, where many square miles of rich n lands have been taken up and prospected.

Regarding this district, the following extracts from a report addressed the Deputy Minister of Agriculture for the Province of Ontario, by . W. W. Russell, of Port Arthur, and dated October, 1890, may be taken a very fair description of the district and its ores:—

'Some five years ago the first discovery of magnetite in this range s made, and a tract taken up by Messrs. Graham & McKellar. The perty was shortly afterwards examined by Mr. D. H. Bacon (now

**Ontario.**

superintendent of the Minnesota Iron Company), and on his report bonded for a long term to a Cleveland party, represented by Major Pickands. No active operations having been begun, the discovery of the iron did not attract general notice in any way, until the finding last fall of another equally extensive and rich deposit, several miles further west on the same range. The result of this was the starting of numerous exploring parties this summer, and the discovery of still other outcrops of the same ore further westward, until now these rich deposits have been traced by outcrops for a length of sixteen miles along the belt.

"Nothing more than a superficial examination of the deposits has been made, in the way of a few surface cross cuts, and an occasional shot to secure unweathered samples; but in many places the ore outcrops boldly, showing a varying width of from ten to fifty feet.

"Before describing these outcrops or surface showings more minutely, I may refer to the geological occurrence of the deposits. They occur as beds in Huronian hornblendic and chloritic schists, which are nearly vertical, having a dip of 86 degrees north, and a strike of N. 75 degrees east. The surface showings indicate that there are several of these beds, the intervening rock having a width of from five to thirty feet. Whether these beds will unite at a depth or maintain their separate identity, is a problem for development work to decide. The Huronian belt has an average width of eight miles, and rests conformably in the folds of the Laurentian rocks, so we may presume its depth (and that of the interbedded magnetite) to be very considerable, practically unlimited.

"The McKellar-Graham property is the most easterly on the range, and its most conspicuous outcrops occur on the summit and both faces of a bluffy ridge running nearly east and west one hundred feet above the level of the Atic Okan River. Mr. D. H. Bacon sampled the surface showing here, taking samples at three inch intervals; and for an aggregate width of eighty feet these samples gave 63½ per cent metallic iron, without more than a trace of titanic acid or phosphorus, and little more than a trace of sulphur. The outcrops here showed three beds of ore.

"Immediately west of the McKellar-Graham property is Sabawe Lake, a sheet of water three miles in length. For some distance west of the lake, in the course of the iron belt, a considerable depth of soil covers everything; this extends to location R400, on which and R401, other outcrops occur very similar to those on the McKellar-Graham property. A similar ridge traverses these locations, and in many places, especially on the southern exposure, which is very steep, large outcrops occur. Having closely examined these and several locations adjoining them on the west, I can speak more definitely of them than of others where my inspection was more cursory; and it may be as well to state re that the ore throughout this range varies but very slightly in aracter or grade—it is virtually identical throughout, though in some aces where greatly exposed to atmospheric action it is of course aner. On location R400, where a natural exposure of ore some enty feet in width occurs, a large number of samples taken at random ve from 66 to 68½ per cent metallic iron. On the location west of is, R401, a surface cross-cut was made this summer which showed 46 et in width of ore; the full width was not ascertained as the cut was andoned on account of the depth of overlying soil and large boulders; me of the ore from this cut, when protected by deep soil, gave as high 71 per cent metallic iron. Ontario.

" A little more than half a mile west of this the ore again outcrops on e south face of a ridge about fifty feet in height, the intervening ound being low; samples from here gave 65 per cent. Half a mile rther west a short trench dug in the low ground showed rich ore at a pth of only three feet; no attempt was made to uncover the width of e deposit, the sole object being to locate it. A mile beyond this merous showings are found along the top and south face of a ridge out 100 feet high; the surface showings here are very extensive, and e ore of the same high grade, 66 to 68 per cent. For nearly three iles beyond this the ground in the line of the deposits is very low, and attempt to locate the ore by test pits, etc., has been made. As the round rises, the ore again outcrops and shows at the crossing of the tic Okan River, which is very rapid at this point.

"To bring the Atic Okan ores to a market, a railway from thirty to fty miles in length will have to be built from near Carlstadt station on he Canadian Pacific Railway to and along the Atic Okan River. An xamination of the route was made by the Canadian Pacific Railway ompany last fall, and their engineer reported it a very easy one, estimating the cost of grading at not over $2,000 per mile for four-fifths of he distance, the balance being medium work only, to cost say $10,000 er mile. The company are not disposed to build the road unless a easonable amount of freight is guaranteed, but are willing to equip and perate the road when built if desired, and to facilitate the successful peration of the mines by cheap freight rates, etc. There is no local raffic for the railway throughout this section, and it is plainly to the nterest of the company to promote to the utmost any undertaking that night lead to making this part of the line a remunerative one through ocal traffic. That they are fully alive to this is very evident in all ntercourse on the subject with the chief officials of the company.

"With regard to the market for these ores, and the cost of delivering hem thereat: Mining will cost from 75 cents to $1.00 per ton, say $1.00

Ontario.

as an outside estimate. Railroad freight to Port Arthur or Fort William, $1.00 per ton. Lake freight to either of the principal ore ports on Lake Erie, Cleveland or Ashtabula, may be taken as the same as that from Ashland or Two Harbours, the shipping ports of the Gogebic and Vermillion districts. The rate last year and during the present season has been about $1.25 per gross ton, and there is no reason to think this will be exceeded in the future, considering the continual increase in numbers and tonnage of vessels built on the lakes. Shipping charges, insurance, etc., may be taken at 30 cents per ton; duty going into the United States, 75 cents per ton. This will give the total cost delivered at a Lake Erie port of $4.30 per ton. The present value of a high grade Bessemer ore, such as this under consideration, delivered on the docks at Cleveland or Ashtabula is $6.00 per ton, which would leave a net profit of $1.70 per ton.

"The Dominion Government gives a bonus of $2.00 for every ton of pig iron manufactured in Canada, and a portion of the Atic Okan ores might be profitably treated at Port Arthur or Fort William, where other ores for mixing, fluxes and fuel can be brought at low rates. Coal is carried here from Lake Erie ports at from 40 to 50 cents per ton, and coke from 80 cents to $1.00. There is no duty on anthracite coal and coke also is admitted free, if for smelting purposes.

" I append hereto a number of analyses of the Atic Okan ore from different parts of the range.

"ASSAYS OF ATIC OKAN MAGNETITE.

" M'KELLAR-GRAHAM LOCATION.

| | Averages by Mr. D. H. Bacon. | | | Chapman. |
|---|---|---|---|---|
| | (1) | (2) | (3) | |
| Silica.... | 6·60 | 7·30 | 5·89 | 2·43 |
| Alumina.... | 1·09 | 1·80 | 0·98 | 0·67 |
| Ferrous ox .... | | | | 23·32 |
| Ferric ox.... | 87·66 | 86·90 | 88·36 | 46·74 |
| Manganese.... | trace. | trace. | trace. | |
| *Calcic (? carbonate).... | 1·28 | 0·90 | 1·40 | |
| Magnesia.... | 0·75 | 0·60 | 0·75 | |
| Phosphoric acid.... | 0·0079 | 0·069 | 0·025 | |
| Titanic acid.... | none. | none. | none. | none. |
| Total.... | 94·46 | 97.57 | 97·41 | |
| Metallic iron.... | 63·47 | 62·84 | 63·97 | 70·06 |

" The first three are averages from the three beds sampled by Mr. Bacon, and the last is a single specimen given Prof. Chapman of Toronto.

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*The original M. S. is not clear here but the carbonate would evidently be intended.

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"AVERAGES TAKEN BY W. W. RUSSELL FROM LOCATIONS R400 AND 401.

| Assayed by | Minnesota Iron Co. | F. Hille, Pt. Arthur. | H. M. Currie for Carnegie Bros. |
|---|---|---|---|
| Metallic iron | 68·50 | 65·90 | 65·702 |
| Silica | 2·90 | 5·80 | 4·20 |
| Phosphorus | 0·015 | 0·001 | 0·003 |
| Sulphur | 0·052 | 0·16 | Not specified. |
| Titanic acid | none. | none. | none. |

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SAYS BY SHARON IRON WORKS, PA., OF SAMPLES FURNISHED BY CAPT. M. N. GARLAND, AS FROM PROPERTY MARKED 'GARLAND LOCATIONS.'

| | |
|---|---|
| Metallic iron | 68·75 |
| Silica | 1·41 |
| Phosphorus | 0·006 |
| Sulphur | 0·185 |

---

"ASSAYS OF ATIC OKAN ORE BY GEOLOGICAL SURVEY OF CANADA

G. C. Hoffmann, Assayer.

| | |
|---|---|
| 1. Magnetite from R402: | |
| Metallic iron | 68·579 |
| Titanium | none |
| 2. Magnetite, R400: | |
| Metallic iron | 68·027 |
| Titanium | none |
| 3. Magnetite from R403: | |
| Metallic iron | 64·551 |
| Titanium | none |
| 4. Magnetite from line between Mining Locations 10E and 11E, collected by Smith: | |
| Metallic iron | 65·710 |
| Titanium | none |

British Columbia.

British Columbia the mine which was the only producer for some s past did not operate during 1890, so that there is no production eport from this province. The following item regarding a recent overy is taken from the report of the Minister of Mines for British mbia:—

About ten miles east of Lytton, by the side of the Canadian Pacific lway track, Mr. James Wilson, Superintendent of the C. P. R. telephs, is the fortunate owner of an extensive iron deposit, which is esented to me as having indications of becoming a valuable property w years hence. Already about $1,000 has been expended towards eloping this mine by sinking and drifting."

Pig Iron.

*ig Iron.* During 1890 the amount of pig iron produced in Canada n Canadian ores was 21,772 tons, valued at $331,688, showing a rease, when compared with the year previous, of 4,149 tons and 8,184. Statistics of this industry will be found in the following table re they are shown in comparison with those of the year previous.

### IRON.

### TABLE 3.

Pig Iron.

### PIG IRON PRODUCTION: CONSUMPTION OF ORE, FUEL, ETC.

| Production and Consumption. | | 1889. | | 1890. | |
|---|---|---|---|---|---|
| | | Quantity. | Value. | Quantity. | Value. |
| Pig Iron made | Tons. | 25,921 | $499,872 | 21,772 | $331,688 |
| Iron Ore consumed | " | 65,670 | 126,064 | 57,304 | 117,880 |
| Fuel consumed | Charcoal . . Bush. | 755,800 | 41,568 | 589,860 | 29,493 |
| | Coke . . . . Tons. | 33,289 | 94,791 | 32,832 | 97,659 |
| | Coal . . . . . " | 3,044 | 6,525 | 1,241 | 2,638 |
| Flux consumed | " | 22,122 | 21.909 | 18,478 | 18.361 |

The number of furnaces in blast during the year was four, and the entire production was utilized in Canada, as there were no exports reported.

Iron and Steel Manufactures.

*Iron and Steel Manufactures.* In table 4 will be found statistics regarding exports of iron manufactures produced in Canada, while in tables 5, 6 and 7 will be found the statistics of imports of all iron products other than highly finished iron and steel goods of which the value of the metal alone represents but a small proportion of the whole.

### IRON.

### TABLE 4.

### EXPORTS OF IRON AND STEEL GOODS, THE PRODUCE OF CANADA.

| Province. | Scrap Iron. | Iron Stoves. | Iron Castings | Iron, all other and Hardware. | Steel and Manufactures of | 1890. Totals. | 1889. Totals. |
|---|---|---|---|---|---|---|---|
| Ontario | $12,410 | $1,517 | $5,571 | $11,756 | $8,404 | $39,658 | $40,679 |
| Quebec | 22 | 665 | 1,926 | 38,061 | 12,853 | 53,527 | 66,570 |
| Nova Scotia | 153 | 753 | 805 | 10,974 | 5,041 | 17,726 | 14,914 |
| New Brunswick | . . . . | 567 | . . . . | 8,110 | . . . . | 8,677 | 7,365 |
| Prince Edward Island | . . . . | 12 | . . . . | 98 | . . . . | 110 | 108 |
| Manitoba | . . . . | 220 | 22 | 332 | 563 | 1,137 | 1,659 |
| British Columbia | 10,040 | 6 | 11 | 1,614 | 1,218 | 12,889 | 13,614 |
| Totals | 22,625 | 3,740 | 8,335 | 70,945 | 28,079 | 133,724 | 144,909 |

**Iron and Steel Manufactures.**

## IRON.

### TABLE 5.

### IMPORTS: IRON IN SLABS, BLOOMS, LOOPS AND PUDDLED BARS, ETC.

| Fiscal Year. | Cwt. | Value. |
|---|---|---|
| 1880 | 195,572 | $244,601 |
| 1881 | 111,666 | 111,374 |
| 1882 | 203,888 | 222,056 |
| 1883 | 258,639 | 269,818 |
| 1884 | 252,310 | 264,045 |
| 1885 | 312,329 | 287,734 |
| 1886 | 273,316 | 248,461 |
| 1887 | 522,853 | 421,598 |
| 1888 | 110,279 | 93,377 |
| 1889 | 80,383 | 67,181 |
| 1890 | 15,041 | 15,923 |

## IRON.

### TABLE 6.

### IMPORTS OF PIG IRON, ETC.

| Fiscal Year. | Pig Iron, Charcoal. | | Pig Iron, all Other. | | Pig Iron, Kentledge, &c. | | Total. | |
|---|---|---|---|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. | Tons. | Value. | Tons. | Value. |
| 1880 | ...... | ...... | 23,159 | $371,956 | ...... | ...... | 23,159 | $371,956 |
| 1881 | ...... | ...... | 43,630 | 715,997 | ...... | ...... | 43,630 | 715,997 |
| 1882 | 6,837 | $211,791 | 56,594 | 811,221 | ...... | ...... | 63,431 | 1,023,012 |
| 1883 | 2,198 | 58,994 | 75,295 | 1,085,755 | ...... | ...... | 77,493 | 1,144,749 |
| 1884 | 2,893 | 66,602 | 49,291 | 653,708 | ...... | ...... | 52,184 | 720,310 |
| 1885 | 1,119 | 27,333 | 42,279 | 545,426 | ...... | ...... | 43,398 | 572,759 |
| 1886 | 3,185 | 60,086 | 42,463 | 528,483 | ...... | ...... | 45,648 | 588,569 |
| 1887 | 3,919 | 77,420 | 46,295 | 554,388 | ...... | ...... | 50,214 | 631,808 |
| 1888 | ...... | ...... | ...... | ...... | 48,973 | $648,012 | 48,973 | 648,012 |
| 1889 | ...... | ...... | ...... | ...... | 72,115 | 864,752 | 72,115 | 864,752 |
| 1890 | ...... | ...... | ...... | ...... | 87,613 | 1,148,078 | 87,613 | 1,148,078 |

**Iron and Steel Manufactures.**

## IRON.

TABLE 7.

IMPORTS OF IRON AND STEEL GOODS.*

| Fiscal Year. | Value. |
|---|---|
| 1880 | $6,620,260 |
| 1881 | 8,484,175 |
| 1882 | 8,578,685 |
| 1883 | 8,613,739 |
| 1884 | 6,143,870 |
| 1885 | 4,606,193 |
| 1886 | 4,698,882 |
| 1887 | 6,084,704 |
| 1888 | 5,147,111 |
| 1889 | 7,108,052 |
| 1890 | 7,260,845 |

## LEAD.

**Production.**

According to returns made to this office there were 113,000 pounds of lead produced during 1890, which at 4½ cents per pound is equivalent to $5,085. This production is altogether that of the provinces of Ontario and Quebec. No operations were undertaken in Nova Scotia and New Brunswick.

**Developments Quebec.**

In Quebec the most important is undoubtedly that known as the Lake Temiscamingue mine on lots 56 to 62, range I of the township of Duhamel, the shaft and workings being on lot 62 near the lake shore. Work was carried on in a desultory way for many years under the management and ownership of Mr. E. V. Wright of Ottawa. During 1890, however, the mine was purchased by American capitalists and active work undertaken, the result being that a shaft already begun was carried to a depth of over 100 feet. From this shaft two drifts were made on the course of the vein, one to the west being 30 feet in length, and known as the 65-foot level, the other in an opposite direction, at about 100 feet from the surface, was carried to a distance of 15 feet, a cross-cut was made at 70 feet which struck the wall on the north-east side at a distance of 20 feet from the shaft. In the 65-foot level a diamond drill test was made to a depth of 75 feet or a total depth of 140 feet from the surface and showed good ore throughout its entire length. On the surface the fissure is plainly shown to be 80 feet in width and has been

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* These figures do not include those of hardware, engines, agricultural implements, or other highly finished iron products.

Quebec.

:ed for a distance of 1,400 feet in a north-easterly direction. The
at drawback to the proper development has always been the distance
n railway communication and the difficulties to be contended with as
ards shipments. The position of the mine is unfortunate in this res-
t, its only means of communication being by the waters of the
awa River, of which Lake Temiscamingue is a part for a distance of
ut 100 miles above Mattawa station. The lower 40 miles of this dis-
ce is broken in many places by rapids and falls, necessitating fre-
nt transhipment. The first portage is made by means of a narrow
ge railway of eight miles in length, the lower rapids requiring short
nways of from one-half to one mile each. Until the completion of
projected railway from Mattawa station on the Canadian Pacific
lway to Lake Temiscamingue, the cost of laying ore or concentrates
:he cars will be in the neighbourhood of $11 per ton. The present
ıers have a very complete mill and mining plant at the works, con-
ing of:—

1 Blake crusher.
2 pair rolls.
2 revolving screens.
4 jigs.
1 revolving table.
1 Corliss engine.
Ingersoll compressor and drills.

'he average of lead in the ore is, according to E. Obalski, Government
ıing Engineer for the province of Quebec, 52 per cent with a content
silver equivalent to 26 ounces per ton. Many other occurrences
known throughout the province of Quebec on which however no
rk was performed during the year.

Ontario.

n Ontario a small amount of development work was done in the
ghbourhood of Black Bay, Lake Superior, where several of the old
perties as well as some recent discoveries of galena were opened and
ted; no shipments were however made.

British Columbia.

'articulars regarding the lead ores of British Columbia will be found
the article on silver, as the ores of that province are highly argen-
rous, and as such have been treated of there. It has been found im-
sible to obtain the amount of lead ore or lead contents shipped from
t province, as the values of all shipments of that metal are included
the total value of the ores for that and the other metals. It is expected
t during the present year increased railway and other facilities will
afforded for the shipment of ores and that in consequence there will
a large production of lead to report from that province.

Imports.

**The only statistics of the lead trade available are those of the imports, which are given below:—**

LEAD.

TABLE 1.

IMPORTS OF LEAD.

| FISCAL YEAR | OLD, SCRAP AND PIG. | | BARS, BLOCKS, SHEETS. | | TOTAL. | |
|---|---|---|---|---|---|---|
| | Cwt. | Value. | Cwt. | Value. | Cwt. | Value. |
| 1880 | | | | | 30,298 | $124,117 |
| 1881 | 16,236 | $ 56,919 | 18,222 | $70,744 | 34,458 | 127,663 |
| 1882 | 36,655 | 120,870 | 10,540 | 35,728 | 47,195 | 156,598 |
| 1883 | 48,780 | 148,759 | 8,591 | 28,785 | 57,371 | 177,544 |
| 1884 | 39,409 | 103,413 | 9,704 | 28,458 | 49,113 | 131,871 |
| 1885 | 36,106 | 87,038 | 9,362 | 24,396 | 45,468 | 111,434 |
| 1886 | 39,945 | 110,947 | 9,793 | 28,948 | 49,738 | 139,895 |
| 1887 | 61,160 | 173,477 | 14,153 | 41,746 | 75,313 | 215,223 |
| 1888 | 68,678 | 196,845 | 14,957 | 45,900 | 83,635 | 242,745 |
| 1889 | 74,223 | 213,132 | 14,173 | 43,482 | 88,396 | 256,614 |
| 1890 | 101,197 | 283,096 | 19,083 | 59,484 | 120,280 | 342,580 |

LEAD.

TABLE 2.

IMPORTS OF LEAD MANUFACTURES.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $15,400 |
| 1881 | 22,629 |
| 1882 | 17,282 |
| 1883 | 25,556 |
| 1884 | 31,361 |
| 1885 | 36,340 |
| 1886 | 33,078 |
| 1887 | 19,140 |
| 1888 | 18,816 |
| 1889 | 16,315 |
| 1890 | 25,600 |

## MANGANESE.

Production.

In the lower provinces of Canada are found many extensive deposits of the various ores of manganese, viz.:—Pyrolusite, manganite and wad, which occur, in the case of the crystalline ores, almost without exception, in rocks of Carboniferous age. That the industry has not been neglected may be evidenced by the fact that, since 1868, the exports of high grade ore amount to over 30,000 tons, the greater part of which went to the United States.

Ores.

The ores are, briefly, as follows:—Pyrolusite, known locally as "grey ore" or "needle manganese," is essentially an anhydrous oxide of manganese having the general formula of $MnO_2$.

Manganite, known locally as "blast furnace ore" or "brown ore," is essentially a hydrous sesquioxide of manganese having the general formula $Mn_2O_3, H_2O$. In appearance it is similar to pyrolusite, except perhaps that it is more generally black, seldom, except in the case of the purer varieties, being greyish black. This ore is readily distinguished from pyrolusite by its streak, which is reddish or brownish black, that of the latter being black to submetallic.

Wad, or bog manganese, is an impure hydrous oxide of manganese occurring generally in bogs or old lake bottoms, in the form of an earthy deposit or in amorphous masses of some size. The composition varies considerably, ranging in content of manganese binoxide from 50 to 75 per cent, with considerable quantities of ferric oxide and small percentages of phosphorus and other impurities.

New Brunswick.

Throughout the southern part of New Brunswick and in the areas underlain by the Carboniferous limestone are many extensive deposits of manganese which have afforded considerable quantities of high class ore. The most important in this province, owing to its extent and development, is undoubtedly that at Markhamville, where the mines of the Pope Manganese Company are situated.

*Pope Manganese Co.*—In the parish of Sussex, Kings Co., and about twelve miles in a direct line south from the town of Sussex, is a small area of Carboniferous limestone, on the north-west side of which are located the mines of the above company. The ore occurs throughout the limestone in the form of beds and pockets, attaining in places large dimensions, as much as 4,000 tons having been produced from one pocket. The discovery of manganese at this point was made in 1862, when it was worked by Mr. Wm. Davidson, of St. John, until 1865, when the property passed into the hands of the Queen Manganese Company, by whom it was operated under the management of Major A. Markham, until the fall of 1889. The Queen Manganese Company then went into liquidation, owing to the failure of the more important members of the company, and the result was the formation in 1890 of the Pope Manganese Company, capital stock $75,000, with the following officers: President, W. C. Pope; treasurer, C. H. Converse; manager and superintendent at mines, A. Markham.

In the extraction of the ore no regular system of mining is attempted nor possible. Owing, however, to the location of the deposits, in a valley cut through the soft limestones, the workings have, until quite recently, taken the form of drifts and open cuts, the hill on the north and west of

New Brunswick.

the property being literally honey-combed with drifts, adits, pits and open cuts. During 1890 Major Markham was making explorations by means of a diamond drill, and had been successful in locating two large ore bodies, both of which were being sunk upon.

Of the ore shipped from this mine two distinct classes are recognized, viz.:—"Blast furnace ore," consisting almost entirely of manganite, and high grade or "grey ore" consisting of pyrolusite.

The following analyses are of "high class manganese ore from Markhamville, New Brunswick," and are taken from "The Mineral Resources of the United States, calendar year 1888," Washington, 1890:—

| | No. 1. | No. 2. | No. 3. |
|---|---|---|---|
| Manganese binoxide | 98·70 | ..... | ..... |
| do peroxide | ..... | 97·25 | 96·62 |
| Silica | 0·55 | ..... | ..... |
| Iron | 0·75 | ..... | ..... |
| Iron peroxide | ..... | 0·85 | 0·78 |
| Barium | Trace. | ..... | ..... |
| Baryta and silica | ..... | 0·95 | 0·85 |
| Water | ..... | Trace. | Trace. |
| Loss | ..... | 0·95 | 1·75 |

For the treatment of their ore the company have a well-equipped mill, in which the following plant is contained:—1 crusher, 2 Cornish jigs, 1 cyclone pulverizer, 1 Bogardus mill, 1 sizing machine and 1 calcining furnace; while the plant in connecting with the extraction of ore consists of 2 hoisting engines, 2 steam pumps, 2 steam drills, 1 diamond drill, complete, as well as a rotary saw-mill.

*Jordan Mountain.*—About five miles north of Sussex, and on the western end of Jordan Mountain, is a deposit of manganiferous limestone throughout which is scattered, in a manner similar to that at Markhamville, more or less extensive deposits of pyrolusite and manganite. Since its discovery in 1882, by the present owner, Mr. F. W. Stockton of Sussex, but little has been done, further than a small amount of development work consisting of stripping and an open cut of about eighty feet in length in the bottom of which in August, 1887, was to be seen a lenticular interbedded mass of manganite and pyrolusite. From this open cut about 400 tons of 80 to 85 per cent ore has been extracted.

*Brunswick Manganese Company.*—The property of this company, consisting of one thousand acres, is situated on a promontory extending into the Bay of Fundy opposite to the village of St. Martin's and known as "Quaco Head." Traversing this high point is a heavy bed of red calcareous shale which is highly charged with manganite, pyrolusite being of much rarer occurrence than in the limestone deposits of the before-mentioned localities. The deposit has been worked in a very desultory manner for many years, energetic operations not having been commenced until the acquisition by the present company, who began rations by driving a tunnel N. N. W. into the shales which show a ff face of about 150 feet in height. This tunnel, on 2nd October, 0, was about sixty feet in length, from which two cross-cuts had been ven at right angles, extending in either direction about twenty feet. these workings numerous pockets, as well as small scattered masses, very hard manganite, suitable for blast furnace purposes, had been ned and the ore extracted, though no shipments had been made.

New Brunswick.

n connection with the mine a well-equipped mill has been erected, plant consisting of one cracker, one pair rolls, one revolving screen, jigs and one 40-horse power engine and boiler. Owing to the posi- of the mine, every facility is afforded for shipping, the ore being direct from the mouth of the tunnel and after treatment in the mill led into self-dumping cars and run direct to the wharf, where it is sible for vessels to load at almost all seasons.

ssays of the ore by A. M. Cowey, of Cambridge, Mass., are as ows :—

| | Compact Variety. | Porous Variety. |
|---|---|---|
| Manganese dioxide | 71·54 | 65·00 |
| Insoluble silicates | 8·37 | 6·66 |
| Ferric oxide | 2·19 | 1·75 |
| Phosphorus | 0·02 | 0·04 |
| Calcium | Trace. | Trace. |
| Metallic manganese | 58·20 | 57·15 |

considerable quantity of lime is generally present in the concen- tes, which, however, does not interfere with their fitness for use the manufacture of steel, for which purpose all the ore from this perty will be used, a contract having been entered into with the rnegie Company of Pittsburg.

*owland Mountain.*—A small amount of exploratory work has been e on the north and north-east side of Gowland Mountain, Elgin ish, where the lessees, Messrs. H. A. Whitney, C. J. Butcher *al*, had, during October, 1890, a small force of men engaged in ving a tunnel and sinking pits, several of which had already been k, showing in all of them small quantities of pyrolusite and manga- e occurring in a very broken and decomposed granite of pre-Cambrian . No shipments have as yet been made, nor has there been any terial production.

his property is peculiar in affording the only instance in New Bruns- k where manganese has been known to occur in appreciable ntity outside of the Carboniferous areas.

New Brunswick.

The following analysis made by Mr. F. D. Adams, assistant chemist to the Geological Survey, is that of a specimen of psilomelane from this property, and was made in 1885:—

| | | |
|---|---|---|
| Manganese dioxide, available | 50·21 | per cent. |
| Ferric oxide | 3·06 | do |
| Insoluble residue | 33·78 | do |

"Agreeably with the results of a qualitative examination, this ore would appear to contain a very appreciable percentage of baryta."

Other localities where manganese, in the form of its crystalline ores, has been noted are, Upham, Waterford, Springfield, Tête-à-Gauche Falls, and many points throughout Albert county. Of one of these, Shepody Mountain, Dr. R. W. Ells, in his report to the Geological Survey for 1884, page 35 E, writes: "The rocks of the mountain" (Shepody Mountain) "rest upon a small outlier of the talco-chloritic schists, which show on the road to the north, leading to Curryville, and are flanked on the east by the grey sandstones of the millstone-grit. On the north-west side a large deposit of manganese was worked for some years, a tunnel being driven into the mountain along the contact with the underlying schists for nearly 1,000 feet, the ore, which consisted of pyrolusite and psilomelane, occurring at the base of the conglomerate in irregular pockets. Operations have been suspended for some years, and the workings have all fallen in. At the mouth of the slope the conglomerates dip N. 15° E. < 15°—20°"

It is understood that negotiations are now pending for the sale of this property by the present owner, Mr. John Murphy.

*Crimora Manganese Company.*—This company own and are operating a property of 260 acres in extent, known as the Duffy property in Dawson settlement, parish of Hillsboro', Albert county, wherein occur considerable areas of wad. These deposits vary in extent and depth, attaining in some places a thickness of over forty feet, to which depth they have been tested. The ore is covered throughout with peaty matter to the depth of about one foot, beneath which it is found in a good state of purity. The mode of working is very simple, consisting first of cross trenching, by which means the ore is partly drained, after which it is excavated and dried in six pans, each 6 by 50 feet, the result being a dry and almost impalpable powder, which is loaded direct into cars of the Salisbury and Harvey Railway, from the main line of which a spur has been built. It is understood that contracts have been entered into with several steel makers in the United States for a supply of ore from this locality.

New Brunswick.

rtial analysis of the ore by Mr. W. F. Best, St. John, gave,—

| | |
|---|---|
| Manganese binoxide | 47·0 |
| Iron oxide | 18·0 |
| Vegetable matter | 34·0 |
| Loss | 1·0 |
| Copper | Trace |
| Cobalt | Trace |
| | 100·0 |

ral analyses by John Burwash gave the following percentages of
nese binoxide:—73·6, 35·5, 58·3, 57·6, 70·7, 63·4, and an assay
imens collected at various points gave an average percentage
l.

Nova Scotia.

e deposits of wad, pyrolusite and manganite occur throughout
ovince of Nova Scotia, the harder or crystalline ores occurring, as
Brunswick, in the greater number of instances in the Carboni-
limestones, whereas wad, the most common of the Nova Scotia ores,
in the form of surface deposits over widely-scattered areas. Space
ot permit of more than a brief mention of the various more
ant localities, among which may be mentioned that at Teny Cape
e other manganese deposits in the immediate neighbourhood of
Basin, Boularderie Island, and throughout the western part of
Breton Island.

*Cape and Minas Basin.*—On the south shore of Minas Basin and
y between Noel and Walton is situated the Teny Cape mine,
since its discovery in 1862, has been operated more or less con-
sly. The ores, consisting mainly of pyrolusite and manganite, are
in the Carboniferous limestone which is traceable for many
n the south shore of Minas Basin, the limestone immediately in
tion with the ore deposits being highly manganiferous and inter-
ied with small beds and masses of a manganiferous calc-shale, the
being usually of a deep red colour. The mode of occurrence is
y, the ore being found in irregular masses and stringers, which
the bedding planes and fractures; some of these pockets are of
erable extent, one affording, it is said, upwards of 1,000 tons of
rade ore.

ery considerable proportion of the ore extracted is high grade
site, selling for from $100 to $125 per ton at the mine, and con-
from 85 to 95 per cent of available binoxide.

following assays taken from an article entitled "Notes on the
nese ores of Nova Scotia," by E. Gilpin, jr., Proc. Roy. Soc. Can.,
, show the character of the ores obtained from Teny Cape and
t.

| | Teny Cape (*a*) | Cheverie (*b*) | Douglas |
|---|---|---|---|
| Manganese oxides | 85·54 | 90·15 | 84·62 |
| Iron peroxide | 1·18 | 2·55 | 0·60 |
| Baryta | 0·89 | 1·12 | 0·72 |
| Insoluble matter | 3·27 | 2·80 | 1·73 |
| Phosphoric acid | 0·34 | 1·03 | .... |
| Water | 8·54 | 2·05 | 5·29 |
| Oxygen | .... | .... | 7·04 |
| | 99·76 | 99·70 | 100·00 |

(*a*) Analyst, Dr. Howe.
(*b*) do E. Gilpin, jr.
(*c*) do H. Poole.

Deposits similar to that at Teny Cape have been worked to a smaller extent at Cheverie, Walton, Noel and Shubenacadie, on the south shore of Minas Basin, while on the north shore no important deposits of manganese have been noted, though some of the limonite and other iron ores of the neighbourhood of Londonderry are highly manganiferous; this is also the case with many of the iron ores of both Colchester and Pictou counties.

The following analyses taken also from Mr. Gilpin's article, mentioned above, show the character of some of these ores, the particular cases cited here being of two limonite ores from Springville, Pictou county.

| | | |
|---|---|---|
| Iron sesquioxide | 10·848 | 48·223 |
| Manganese oxide | 62·950 | |
| do peroxide | ...... | 14·410 |
| Magnesium | 1·630 | |
| Lime | 7·280 | 0·015 |
| Alumina | 2·880 | Trace |
| Baryta | 0·670 | |
| Sulphur | .... | 0·480 |
| Phosphorus | ...... | 0·020 |
| Insoluble residue | 2·731 | 25·130 |
| Water of composition | ...... | 12·530 |
| Moisture | 1·450 | |
| | 90·439 | 100·808 |

*Cape Breton.*—Among the more important deposits of Cape Breton Island may be mentioned those on Loch Lomond, which have been exploited by the Hon. E. T. Moseley, of Sydney. In the report of the Geological Survey, 1882–84, Mr. Hugh Fletcher writes of the deposits as follows:—"Large deposits of pyrolusite, which promise to be of great importance, have recently been discovered and developed by the Hon. E. T. Moseley, of Sydney, on the south side and near the head of Loch Lomond, in Cape Breton county. The ore is associated with lower Carboniferous rocks and has been worked in two places about three-quarters of a mile apart. At the most easterly of these, in a brook on the farm of Norman Morrison, a tunnel has been driven about thirty feet on a vein about seven inches thick, dipping N. 87° W. < 25° in fine red sandstone overlying reddish and greenish grit, with grains of quartz about the size of wheat and red marly sandstone. The ore is irregularly mixed with red and grey bituminous limestone, red and greenish shale conglomerate and other rocks blotched with calc-spar. It is in lenticular layers and also intimately mixed with the limestone, being probably of the same nature and origin as the hematite and forming at times a cement for the pebbles of the comglomerate * * * The mines were first worked in 1880. In 1881 about 70 tons, and in the following year 59 tons of excellent ore were shipped to the United States, * * * An analysis of a sample from the Morrison mine afforded Mr. Adams 91·84 per cent of manganese dioxide, only ·12 per cent of ferric oxide and 2·91 per cent of insoluble residue."

Many other deposits, both of crystalline ores and wad, are known to exist throughout the island. One of these on Boularderie Island is said to be quite extensive, and the character of the ore may be judged from the following assays:—

| | I. | II. | III. |
|---|---|---|---|
| Manganese peroxide | 25·42 | 11·04 | 44·33 |
| Iron sesquioxide | | 12·49 | 35 50 |
| Insoluble matter | | 57·76 | 10·00 |
| Water | 33·52 | .. .. | ...... |

I and II by G. C. Hoffmann, Chemist Geological Survey. III by E. Gilpin, jr., Trans. Royal Society of Canada, Vol. II, sec. IV.

Quebec.

*Quebec.*—In many places throughout the province of Quebec are small deposits of manganese, principally in the form of wad. One of these occurs on the St. Louis road, about four miles from Quebec, where it covers an area of about 300 yards square and is about twelve inches in thickness. Similar deposits occur in Stanstead, Bolton, Tring, Aubert Gallion, St. Mary's and other parishes, but nowhere in sufficient quantity for commercial purposes.

Of manganese occurring on the Magdalen Islands, Mr. Jas. Richardson, in the report to the Geological Survey, 1879–80, writes :—"Immediately under Demoiselle Hill, on Amherst Island, numerous blocks charged with peroxide of manganese, or pyrolusite, occur among the debris of the fallen cliffs. They are in pieces varying from one pound to ten or fifteen pounds in weight. There can be little doubt that they are derived from a deposit more or less regular in the hill side, but which is now completely concealed by the fallen debris. At a place bearing nearly due west from Cap aux Meules, at the distance of about a mile, and close to the English Mission church, similar pieces to those above-described are very frequently picked up." Assays of this ore, in the same volume, gave :—

| | | |
|---|---|---|
| Manganese dioxide | 45·61 | per cent. |
| Water, hygroscopic | 0·10 | do |

Ontario.

*Ontario.*—A considerable deposit of manganese is, according to the 'Geology of Canada, 1863," reported as occurring on Batchewahnung

Bay, Lake Superior. The ore is said to be manganite and to assay 60 per cent of peroxide of manganese. No other occurrences have been reported authentically.

Production.

During the year 1890 manganese ore to the extent of 1,328 tons was mined and shipped, the value being, according to direct returns made to this office, $32,550. The price per ton, as shown by the above figures, is about $24.50, which, compared with that of the year previous, shows an increase of $2.00.

The production for the past four years has been,—

| | | | |
|---|---|---|---|
| 1886 | 1,789 | tons | $41,499 |
| 1887 | 1,245 | do | 43,656 |
| 1888 | 1,801 | do | 47,944 |
| 1889 | 1,455 | do | 32,737 |

It was all mined in New Brunswick and Nova Scotia.

According to the reports of the Department of Mines for Nova Scotia, the production of manganese in that province since 1877 has been as follows:—

| | | | | | |
|---|---|---|---|---|---|
| 1877 | 97 | tons. | 1884 | 302¼ | tons. |
| 1878 | 127 | do | 1885 | 353½ | do |
| 1879 | 145 | do | 1886 | (a) 427 | do |
| 1880 | 223 | do | 1887 | 691 | do |
| 1881 | 231 | do | 1888 | 88 | do |
| 1882 | 205 | do | 1889 | 67 | do |
| 1883 | 150 | do | 1890 | 112 | do |

(a.) 250 tons from Cornwallis should more correctly be classed as an ochre.

Exports.

The following tables give the exports of manganese ore since 1868, the greater proportion in latter years going to the United States:—

MANGANESE.

TABLE 1.

EXPORTS OF MANGANESE ORE PRIOR TO 1873.

| FISCAL YEARS. | NOVA SCOTIA. | | NEW BRUNSWICK. | | TOTAL. | |
|---|---|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. | Tons. | Value. |
| 1868 | 156 | $4,700 | 861 | $19,019 | 1,017 | $23,719 |
| 1869 | 156 | 4,695 | 332 | 6,174 | 488 | 10,869 |
| 1870 | 1,256 | 4,102 | 146 | 3,580 | 1,402 | 7,682 |
| 1871 | 102 | 1,608 | 954 | 8,180 | 1,056 | 9,788 |
| 1872 | 131 | 4,005 | 1,075 | 24,495 | 1,206 | 28,500 |
| 1873 | ........ | ........... | 838 | 17,171 | 838 | 17,171 |

### MANGANESE.

### TABLE 2.

### EXPORTS OF MANGANESE ORE SINCE 1873.

| 'EARS. | NOVA SCOTIA. | | NEW BRUNSWICK. | | TOTAL. | |
|---|---|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. | Tons. | Value. |
| .. .. ....... | ...... | ......... | 1,031 | $20,192 | 1,031 | $20,192 |
| . .... ..... | 6 | $ 12 | 776 | 16,961 | 782 | 16,973 |
| . .. ..... | ........ | 200 | 194 | 5,314 | 203 | 5,514 |
| ........ .... | 21 | 723 | 391 | 7,316 | 412 | 8,039 |
| ............ | 106 | 3,699 | 785 | 12,210 | 891 | 15,909 |
| . ...... .... | 106 | 4,889 | 520 | 5,971 | 626 | 10,860 |
| . . ....... | 154 | 7,420 | 1,732 | 20,016 | 1,886 | 27,436 |
| ......... | 79 | 3,090 | 2,100 | 31,707 | 2,179 | 34,797 |
| .......... | 200 | 18,022 | 1,504 | 22,532 | 1,704 | 40,554 |
| .. . ..... | 123 | 11,520 | 771 | 14,227 | 894 | 25,747 |
| .. ..... .... | 313 | 8,635 | 1,013 | 16,708 | 1,326 | 25,343 |
| ....... .... | 134 | 1,054 | 469 | 9,035 | 603 | 20,089 |
| . ......... | 77 | 5,054 | 1,607 | 29,595 | 1,684 | 34,649 |
| .. .......... | (a) 441 | 854 | 1,377 | 27,484 | (a)1,818 | 58,338 |
| .. .... ... | 578 | 14,240 | 837 | 20,562 | 1,415 | 34,802 |
| ...... .... | 87 | 5,759 | 1,094 | 16,073 | 1,181 | 21,832 |
| ....... ..... | 59 | 3,024 | 1,377 | 26,326 | 1,436 | 29,350 |
| . ... . .... | 177 | 2,583 | 1,729 | 34,248 | 1,906 | 36,831 |

50 tons from Cornwallis included in this quantity more properly come under the ineral pigments.

mports of oxide of manganese (presumably manufactured) into can only be given for the past seven years and are as follows:— Imports.

### MANGANESE.

### TABLE 3.

### IMPORTS: OXIDE OF MANGANESE.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1884.. .. ........... ... | 3,989 | $ 258 |
| 1885......... ... ... | 36,778 | 1,794 |
| 1886.......... . ...... | 44,967 | 1,753 |
| 1887.................. | 59,655 | 2,933 |
| 1888........ ..... .... | 65,014 | 3,022 |
| 1889........... . .... | 52,241 | 2,182 |
| 1890.................. | 67,452 | 3,192 |

## MICA.

industry has come to the front lately, on account of the demand mineral for electrical purposes.

'½

Mica ; occurrence, etc.

The sources of the mica mined during the year have been the deposits occurring in the Laurentian rocks of the valley of the Gatineau River, Ottawa county, P.Q., and of that section of country in Eastern Ontario tributary to the Kingston and Pembroke Railway,—the former district with headquarters at Ottawa and the latter at the village of Sydenham.

Nearly all the shipments of the year have consisted of the quality known as "amber" or "brown" mica, which is a magnesia mica of the phlogopite species, as distinguished from the "muscovite" or potash mica, which has been commonly used for stove purposes. This latter variety was, until recently, shipped from the Villeneuve mica mine, in the township of the same name, Ottawa county, P.Q., which, however, has ceased operations.

This "amber mica" of the trade occurs chiefly in the crystalline limestone of the Laurentian system, and occasionally also in the pyroxenic belts of the same. It occurs as aggregates of crystals of various sizes, or in veins of more or less regularity, and is generally associated with more or less phosphate, forming a very common associated mineral, in the deposits proper of this substance. Some of the worked deposits, however, yield it free from intermixed substances.

Some of the mines have yielded crystals of considerable size, having been known to produce cut sheets as large as 24 x 14 inches, whilst a crystal lately found in one of the mines in the Gatineau district measured three feet across and over five feet in length.

The potash mica or muscovite occurs generally, as at the Villeneuve mine, in the coarsely crystallized granitic veins and intrusions, of which it forms a constituent, along with the associated felspar and quartz.

On none of the mines have very considerable developments been made, the depth attained not exceeding 168 feet in the deepest of them, which has been worked for some years, whilst the length of the vein explored at that place would be comprised within 210 feet, and the average force of men employed at this mine would not range over 30. Returns were received from eight operators, but the grand total was augmented considerably by the product of desultory mining by small producers, of whose output, however, a close estimate was obtained.

From some of the mines mica is shipped only in the uncut state as selected crystals, whilst others have cutting sheds, and send away their product in this shape, the waste resulting from this process is sold, to be ground and used in the manufacture of lubricants, fireproof roofing, cement, ornamental pigments, etc.

The proportion of this waste to the yield of cut mica is considerable, as it takes from 7 to 10 or even 20 tons of selected crystals to yield 1 ton of clean cut mica.

Production. Owing to the desultory nature of much of the mining done and reticence on the part of some producers, considerable difficulty has been experienced in getting the exact amount and value of the marketed production of this mineral for 1890. Direct returns give 770,959 lbs. of all sorts of mica, valued at $68,074. A firm in the trade gave us $72,000 as their estimate of the value of the whole marketed product of of mica, but consider the total quantity, given above as marketed, as altogether too high.

The above totals, as computed from direct returns, are made up as follows:—

MICA.

TABLE 1.

PRODUCTION.

| — | Quantity. | Value. | Average Value. |
|---|---|---|---|
| Electrical mica.. .... ...... .... | 400,559 lbs. | $58,625 | About $292.25 per ton. |
| Stove " ..... ..... .. . | 3,400 " | 8,500 | " 2.50 per lb. |
| Waste " ...... ......... | 367,000 " | 949 | " 5.00 per ton. |
| | 770,959 lbs. | 68,074. | |

Markets and prices. Most of the Canadian mica is marketed in the United States, being taken by manufacturers of electrical machinery; a small proportion of this quality being sold for similar purposes in the Dominion itself. Some dealers call for it ready cut, whilst others prefer to get it in the shape of selected crystals and cut for themselves. This causes a great variation in the value of the product as shipped from the mine, and makes it hard to strike an average price, which difficulty is emphasized by the great difference in value between the large and small sizes.

Block mica for electrical purposes sells at different prices per ton, according to the size which each block will cut clear of all cracks and flaws, the prices varying all the way from $25 to $200 per ton according to their excellence in this respect.

The demand for waste and small crystals for the various purposes already mentioned is not nearly equal to the possible supply, as the quality called for is not only produced in large quantities as a waste product in cutting the larger crystals, but could also be afforded by the smaller crystals occurring so plentifully in many cases in some of the phosphate deposits of the same district and obtained in working them.

Mica; uses.

For lubricator manufactures it must, of course, be free from grit. Thus, to be worked at a profit, a deposit must yield a good proportion of crystals of sufficient dimensions and clear enough from faults to cut to good sizes.

The darker colour of the magnesia micas (phlogopite and biotite), whilst not affecting them for the electrical trade, renders them less fitted for use in the construction of stoves than the clearer potash mica (muscovite), whilst the frequency with which the latter is stained by deposition of iron oxides between the laminæ and its consequently lowered insulating power militates against its fitness for electrical purposes.

The stove trade also calls in general for larger sizes on the average than the electrical trade, which latter provides the greater part of the consumption.

The 35 per cent. duty imposed on mica entering the United States by the McKinley tariff will, of course, lessen considerably the profits of this industry.

Exports.

The value of this mineral exported is given in the books of the Customs Department as follows:—

| | |
|---|---|
| Mica, crude and cut | $19,171 |
| " ground | 3,297 |
| | $22,468 |

But it is evident that all that was exported was not entered, or was entered at much below its true value.

Imports into U. S. A.

The following figures of the imports of mica into the United States illustrate the extent of the chief market for the Canadian production of this mineral. For the calendar year 1890 the total amount from all countries was valued at $220,702. The total for the fiscal year ending 30th June, 1890, was $146,975, made up as under:—

| | |
|---|---|
| Germany | $ 3,506 |
| England | 64,611 |
| Canada | 25,105 |
| British East Indies | 49,058 |
| Sweden and Norway | 4,695 |
| | $146,975 |

Electrical Trade demands.

In answer to enquiries, the Edison General Electric Company of the United States kindly furnish the following information regarding the requirements of the electrical trade with regard to mica:—

"The bulk of mica used by us is Canadian mica, which is known in the market as 'Amber Mica,' being of amber colour and clear. It is essential that the mica should be smooth, free from wrinkles or crevices, it must split readily, and must be flexible, so much so that a piece of mica ·010″ thick would bend to a curvature of about 3″ diameter without cracking. Mica that has dark spots or coloured spots similar to rainbow colours, or what is known as smoky mica, is not at all suitable for electrical purposes. Mica must also stand a flame of intense heat without crumbling up or showing any disintegration.

" We give you below the principal sizes of mica used by us, and would say that at the present time we have orders out for some of the sizes, ranging from 200 to 600 pounds :

COMMUTATOR MICA.

1½ × 4 inches.
1¼ × 6⅝ "
1⅝ × 4¼ "
1⅜ × 6½ "
1⅜ × 8 "
1¾ × 8 "
2 × 5 "
2½ × 5 "
2 × 7 "
2 × 12 "
2½ × 12 "
4 × 4 "
5 × 8 "

BINDING MICA.

1¼″ wide."

Discovery and development.

Mention is made of mica in the reports on the recently-surveved townships of Cleland and Gladman, in the report of the Commissioner of Crown Lands for Ontario for 1890. The former township is twelve miles south-east from Sudbury, and the report states " there has been a mining location surveyed in the northern part of the township, where I saw some fine deposits of white mica, which had been stripped and some blasting done." The other township, Gladman, is situated some 20 miles north of Lake Nipissing, and the survey report speaks of " large quartz veins seen all over the township and on the shores of a small lake, in which were found some very fine specimens of white mica." The rock of the vicinity was granitic.

## MINERAL PIGMENTS.

Baryta.

*Baryta.*—Of the many extensive deposits of baryta (sulphate of barium or heavy spar) in Canada, only two were being mined during the past year and the production was small. The most important is undoubtedly that of McKellar's Island in Lake Superior, now operated by

Baryta.

the United States Baryta Company, of Cleveland, Ohio; the other deposit is that of Messrs. A. G. Peuchen & Co., of Toronto, in the township of Hull, Quebec, where the mineral occurs in a strong and well-defined vein of about three feet in width.

The vein at McKellar's Island is perhaps the largest on the continent, and is certainly the most extensive in Canada, attaining a gross thickness of about sixty feet, which, whilst made up in a great measure of calcite and quartz, carries, however, a rib of considerable thickness of clear baryta.

The production for the year amounted to 1,842 tons, valued at $7,543 at the point of production, all of which, with the exception of a small amount used in Toronto, was exported to the United States.

The imports of baryta for the past eleven years are given below:—

MINERAL PIGMENTS.

TABLE 1.

IMPORTS OF BARYTA.

| Fiscal Year. | Cwt. | Value. |
|---|---|---|
| 1880 | 2,230 | $1,525 |
| 1881 | 3,740 | 1,011 |
| 1882 | 497 | 303 |
| 1883 | .......... | 185 |
| 1884 | ......... | 229 |
| 1885 | 7 | 14 |
| 1886 | .......... | 62 |
| 1887 | 379 | 676 |
| 1888 | 236 | 214 |
| 1889 | 1,332 | 987 |
| 1890 | 1,322 | 978 |

Ochres.

*Ochres.*—Ochres were produced during the past year in Ontario and Quebec, in the former province in the townships of Walsingham and Esquesing, and in Quebec in the neighbourhood of Three Rivers. These deposits have all been operated in previous years, so that there is no newly-worked discovery to report.

The so-called paint beds of Campbellville, Halton county, Ontario, are now drawn upon to furnish the colouring material for certain varieties of terra cotta produced by the various terra cotta makers in that neighbourhood.

A new brand of metallic paint has during the past two years sprung into prominence, viz., the "Magnetic Paint" made by the Wm. Johnson Company, of Montreal. This paint is made directly from the ochres of Point du Lac and vicinity, deposits similar to which occur throughout the province. The paint, as prepared and sold by the above firm, has proved itself to be of excellent quality, affording a very good colour for indoor work and an exceptional paint for outdoor work, such as structural iron work, bridges, &c.

Canadian ochres prepared by this firm are now being sold in England and South America, as well as in large quantities in the United States.

The production of ochres for the past year was 275 tons, valued at $5,125. Compared with last year, this shows a decrease of 519 tons. The production of ochres for the past four years has been as follows:—

| | | |
|---|---|---|
| 1887 | 385 tons, | valued at $ 2,233 |
| 1888 | 397 " | " 7,900 |
| 1889 | 794 " | " 15,280 |
| 1890 | 275 " | " 5,125 |

The imports for the past eleven years are given below:—

MINERAL PIGMENTS.

TABLE 2.

IMPORTS OF OCHRES.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880 | 571,454 | $ 6,544 |
| 1881 | 677,115 | 8,972 |
| 1882 | 731,526 | 8,202 |
| 1883 | 898,376 | 10,375 |
| 1884 | 533,416 | 6,398 |
| 1885 | 1,119,177 | 12,782 |
| 1886 | 1,100,243 | 12,267 |
| 1887 | 1,460,128 | 17,067 |
| 1888 | 1,725,460 | 17,664 |
| 1889 | 1,342,783 | 12,994 |
| 1890 | 1,394,811 | 14,066 |

Litharge.

*Litharge.*—Although considerable quantities of this substance are used annually in Canada, not only for paint, but in the purification of petroleum, no effort has as yet been made to produce it in the country. The only statistics, therefore, available are the imports which are given below:—

### Mineral Pigments.

Table 3.

Imports of Litharge.

| Fiscal Year. | Cwt. | Value. |
|---|---|---|
| 1880 | 3,041 | $14,334 |
| 1881 | 6,126 | 22,129 |
| 1882 | 4,900 | 16,651 |
| 1883 | 1,532 | 6,173 |
| 1884 | 5,235 | 18,132 |
| 1885 | 4,990 | 16,156 |
| 1886 | 4,928 | 16,003 |
| 1887 | 6,397 | 21,865 |
| 1888 | 7,010 | 23,808 |
| 1889 | 8,089 | 31,082 |
| 1890 | 9,453 | 31,401 |

## MINERAL WATER.

Although a comparatively old industry, the production of mineral waters has increased to a very considerable extent during the past few years. That the consumption is yearly becoming much greater is evidenced by the great growth in the quantities imported.

No new features geologically, nor to any great extent geographically, are afforded by the facts relating to the production of mineral waters during the year, the celebrated springs at St. Leon, St. Hyacinthe and Ste. Genevieve in Quebec, and Caledonia and Winchester Springs in Ontario, affording as in former years the greater proportion of the total production.

Nova Scotia.

In Nova Scotia a locality that has been known and resorted to for many years has lately sprung into greater prominence, and now affords a very considerable quantity of a water of rare medicinal properties. The locality referred to is known as Wilmot Spa Springs, in the village of Wilmot, where the water is used to a large extent in the manufacture of soda water, &c.

New Brunswick.

In New Brunswick the spring at Apohaqui has for the first year an output to report. The water is alkaline and is very similar in composition and taste to the celebrated Vichy water. An analysis by W. F. Best, of St. John, gave for 100,000 parts of water,—

| | Grains. |
|---|---|
| Potassium sulphate | ·50 |
| do chloride | 1·08 |
| Calcium carbonate | 1·25 |
| Sodium chloride | 76·00 |
| do bicarbonate | 201·60 |
| Magnesium | Tracés. |
| Iron | Traces. |
| Silica | ·90 |
| Organic matter | Traces. |
| Grains | 281·33 |

This water has proved itself an excellent emulsifier of the fatty oils, rticularly of cod liver oil, for which purpose it is eminently suitable.

Ontario and Quebec.

Of the springs in Ontario and Quebec little need be said, as outside of t at Brechin, on Lake Simcoe, they are well known, and without an eption report large increases in their production. Regarding echin a word may be said here. The spring is situated near the vile of Brechin, on Brechin Beach, and at an elevation of about fifty t above Lake Simcoe. The water known and sold as "Eudo mineral ter" gave, on analysis by Mr. Thos. Heys, of Toronto, the following tent per imperial gallon:—

| | Grains. |
|---|---|
| Bicarbonate of soda | 35·000 |
| Sulphate of potash | 3·968 |
| Chloride of sodium | 201·096 |
| do of potassium | 5·480 |
| do of magnesium | 35·344 |
| do of calcium | 42·176 |
| Carbonate of iron | 2·160 |
| Silica and alumina | 1·744 |
| Free ammonia | ·120 |
| Organic ammonia | ·008 |
| Grains | 327·096 |

| | Cubic inches. |
|---|---|
| Sulphuretted hydrogen | 105·20 |
| Carbonic acid gas | 5·728 |

N. W. Territories.

Throughout the North-West Territories so many of the waters are aline or saline that special mention of any is not necessary.

British Columbia.

* Returns were received from British Columbia of water afforde the "Harrison mineral spring," which is now being aerated and bot and sold extensively throughout the province.

Outside of those waters shipped from their point of production, v considerable quantities are annually used on the spot at the var sanitariums throughout the Dominion, notably that at Banff, N.W Preston, London, Winchester and Caledonia in Ontario, St. Leor Quebec, and Wilmot, N.S.

Production.

The production for the past year was 561,165 gallons, valued $66,031, showing an increase over the previous year of 136,565 gall and $28,671. The quantities produced and shipped for the past tl years, according to returns received at this office, have been :—

| | | |
|---|---|---|
| 1888 | 124,850 gallons | $11,456 |
| 1889 | 424,600 " | 37,360 |
| 1890 | 561,165 " | 66,031 |

Exports and Imports.

The quantities exported (if any) are but slight, and are not tal cognizance of as such by the Customs Department. The imports however given for the past eleven years in the following table :—

MINERAL WATERS.

TABLE 1.

IMPORTS.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $15,721 |
| 1881 | 17,913 |
| 1882 | 27,909 |
| 1883 | 28,130 |
| 1884 | 27,879 |
| 1885 | 32,674 |
| 1886 | 22,142 |
| 1887 | 33,314 |
| 1888 | 38,046 |
| 1889 | 30,343 |
| 1890 | 40,802 |

Most of the waters imported are from Europe, small quantities onl being from the United States.

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* *See* Geological Survey of Canada, Annual Report, Vol. IV, 1888-89, pp. 13 to 16 r.

## MISCELLANEOUS.

Production.

·oduction of those substances for which separate articles are not necessary may be found in the following table :—

MISCELLANEOUS.

TABLE 1.

PRODUCTION.

| Product. | 1889. | | 1890. | |
|---|---|---|---|---|
| | Quantity. | Value. | Quantity. | Value. |
| Felspar.. .... | ... .... | .......... | 700 tons | $ 3,500 |
| Glass ......... | ....... .... | $150,000 | ... .... | 537,130 |
| Moulding sand. | 170 tons | 850 | 320 tons | 1,410 |
| Platinum ..... | ... ..... | 3,500 | ......... | 4,500 |
| Quartz......... | .......... | ...... . | 200 tons | 1,000 |
| Soapstone.. .. | 195 tons | 1,170 | 917 do | 1,239 |
| Whiting. .... | ........ | ........ | 500 bbls | 500 |

Felspar.

:*r.*—During 1890 the production of felspar amounted to 700 ued at $3,500. Of this the greater part is exported, going to N. J., and other china and earthenware producing centres in ed States, a small quantity only being used in domestic factories, at St. Johns, Quebec, where it is used in the manufacture of pottery and china. On account of its superior quality and from impurity the Canadian felspar is particularly valuable ncreased output is confidently looked for.

Glass.

—As the result of the operations of four producers there was an ı Canada during 1890 of $537,130 worth of glass and glassware. duction consisted entirely of "green" and "flint" glass and a ıount of brown glass bottles, there being no window-glass manu- in the Dominion. The production for the two previous years, ıed to this office, was in 1888 $375,000 and in 1889 $150,000.

ıearly all this production is utilized in Canada is established by that the value of the exports amounted to only $12,015 during , as follows:—

| | |
|---|---|
| Ontario.................. ......................... ...... | $1,374 |
| Quebec................................................. | 9,858 |
| Nova Scotia........................ . ....... ...... | 409 |
| New Brunswick....... .............................. | 269 |
| Manitoba........ ..................... ........... ........ | 92 |
| British Columbia ......................... ........... | 13 |

The exports for the past four years were:—

| | |
|---|---|
| 1887 | $1,030 |
| 1888 | 1,739 |
| 1889 | 6,287 |
| 1890 | 12,015 |

The following table shows the value of glass imported for the past eleven years:—

MISCELLANEOUS.

TABLE 2.

IMPORTS OF GLASS AND GLASSWARE.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $ 650,092 |
| 1881 | 889,803 |
| 1882 | 1,184,716 |
| 1883 | 1,176,912 |
| 1884 | 996,483 |
| 1885 | 1,020,882 |
| 1886 | 1,144,222 |
| 1887 | 1,269,288 |
| 1888 | 1,203,537 |
| 1889 | 1,205,090 |
| 1890 | 1,230,585 |

In the figures given above for the year 1890 is included an importation of window-glass of $311,753.

Moulding sand.

*Moulding Sand.*—In the report of the Department of Mines, Nova Scotia, for 1890, the production of moulding sand in that province is stated to have been 320 tons from Newport, near Windsor, and from River Hébert. Outside of those for Nova Scotia, no figures were obtained of the production of moulding sand, which, on account of the many foundries using local sands, must be considerable.

Platinum.

*Platinum.*—As in previous years, the production of platinum is altogether that of British Columbia, where it is found associated with gold in placer deposits, more especially on the Tulameen and Similkameen rivers and tributaries.

According to the report of the Minister of Mines of British Columbia, the production in that province during the year 1890 had a value of $4,500, showing over 1889 an increase of $1,000. The annual production since 1887 has been:

| | |
|---|---|
| 1887 | $5,600 |
| 1888 | 6,000 |
| 1889 | 3,500 |
| 1890 | 4,500 |

The following table gives the imports of this metal in all forms :—

### MISCELLANEOUS.

### TABLE 3.

### IMPORTS OF PLATINUM.

| Fiscal Year. | Value. |
|---|---|
| 1883 | $ 113 |
| 1884 | 576 |
| 1885 | 792 |
| 1886 | 1,154 |
| 1887 | 1,422 |
| 1888 | 13,475 |
| 1889 | 3,167 |
| 1890 | 5,215 |

Soapstone.

*Soapstone.*—During 1890 there was a production of soapstone of 917 tons, valued at $1,239, all of which was utilized in the manufacture of roofing cement, for which purpose it is ground and mixed with a certain proportion of mica or actinolite fibre.

Whiting.

*Whiting.*—The production of this material, as in previous years, is but small, amounting to only 500 barrels, having a spot value of $500. The only works in operation are situated at Marlbank, Ont., where Messrs. W. P. & A. N. Allan manufacture whiting from the marl found at that place. These works were not visited by any of the staff, nor is the method of manufacture known, though it is presumed that it is the same as that adopted in the manufacture elsewhere, viz. :—grinding and lævigation.

According to the following table of imports, there was during 1890 a market in Canada for 96,243 cwts. or 28,295 barrels of 340 pounds each, having a value, including freight and charges, of $27,471, or about 97 cents per barrel. As the material produced at Marlbank is sold for $1 per barrel in the face of foreign importations, and as there are in many parts of Canada marl-beds similar to that at Marlbank, it does not seem unreasonable to suppose that ere long the manufacture of whiting will acquire much greater proportions.

### MISCELLANEOUS.

### TABLE 4.

### IMPORTS OF WHITING.

| Fiscal Year. | Cwts. | Value. |
|---|---|---|
| 1880 | 84,115 | $26,092 |
| 1881 | 47,480 | 16,637 |
| 1882 | 36,270 | 16,318 |
| 1883 | 76,012 | 29,334 |
| 1884 | 76,268 | 28,230 |
| 1885 | 67,441 | 23,492 |
| 1886 | 65,124 | 25,533 |
| 1887 | 47,246 | 15,191 |
| 1888 | 76,619 | 20,508 |
| 1889 | 84,658 | 22,735 |
| 1890 | 96,243 | 27,471 |

Chalk.

*Chalk.*—The following table illustrates the imports of chalk and cliff-stone, and represents the consumption of those materials in Canada, as there is no home production, chalk not being known to occur in the Dominion.

### MISCELLANEOUS.

### TABLE 5.

### IMPORTS OF CHALK.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $2,117 |
| 1881 | 2,768 |
| 1882 | 2,882 |
| 1883 | 5,067 |
| 1884 | 2,589 |
| 1885 | 8,003 |
| 1886 | 6,583 |
| 1887 | 5,635 |
| 1888 | 5,865 |
| 1889 | 5,336 |
| 1890 | 7,221 |

Mercury.

*Mercury.*—Although known for many years to occur in British Columbia, no efforts to exploit the known deposits have as yet been made, though it is said that a company of Victoria capitalists has recently been formed for the purpose of developing a deposit lately found on Sechart Channel, Barclay Sound, where ore said to afford 20 lbs. of mercury to the ton is stated to occur in no inconsiderable quantity. The localities in British Columbia where this metal is known to exist, though in small quantity, are, according to Dr. G. M. Dawson, in his t on "The Mineral Wealth of British Columbia," Geological Sur- ?eport, 1887:—"Ebenezer mine," 3 miles from Golden; on the side of the Homathco river; near Boston Bar, Fraser river; 12 above Kelly's Lake creek, Fraser river; and Silver Peak, near

there is no production to report from Canada the only statistics ıble are those of the imports given below.

Imports.

MISCELLANEOUS.

TABLE 6.

IMPORTS OF MERCURY.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1882 | 2,443 | $ 965 |
| 1883 | 7,410 | 2,991 |
| 1884 | 5,848 | 2,441 |
| 1885 | 14,490 | 4,781 |
| 1886 | 13,316 | 7,142 |
| 1887 | 18,409 | 10,618 |
| 1888 | 27,951 | 14,943 |
| 1889 | 22,931 | 11,844 |
| 1890 | 15,912 | 7,677 |

ı *and Zinc.*—The following tables give the imports of these metals, ›r of which have as yet been produced in Canada:—

Tin and zinc imports.

MISCELLANEOUS.

TABLE 7.

IMPORTS OF TIN AND TINWARE.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $ 281,880 |
| 1881 | 413,924 |
| 1882 | 790,285 |
| 1883 | 1,274,150 |
| 1884 | 1,018,493 |
| 1885 | 1,060,883 |
| 1886 | 1,117,368 |
| 1887 | 1,187,312 |
| 1888 | 1,164,273 |
| 1889 | 1,243,794 |
| 1890 | 1,289,756 |

### MISCELLANEOUS.

### TABLE 8.

### IMPORTS OF ZINC IN BLOCKS, PIGS AND SHEETS.

| Fiscal Year. | Cwts. | Value. |
|---|---|---|
| 1880 | 13,805 | $67,881 |
| 1881 | 20,920 | 94,015 |
| 1882 | 15,021 | 76,631 |
| 1883 | 22,765 | 94,799 |
| 1884 | 18,945 | 77,373 |
| 1885 | 20,954 | 70,598 |
| 1886 | 23,146 | 85,599 |
| 1887 | 26,142 | 98,557 |
| 1888 | 16,407 | 65,827 |
| 1889 | 19,782 | 83,935 |
| 1890 | 18,236 | 92,530 |

### MISCELLANEOUS.

### TABLE 9.

### IMPORTS OF ZINC, MANUFACTURES OF.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $ 8,327 |
| 1881 | 20,178 |
| 1882 | 15,526 |
| 1883 | 22,599 |
| 1884 | 11,952 |
| 1885 | 9,459 |
| 1886 | 7,345 |
| 1887 | 6,561 |
| 1888 | 7,402 |
| 1889 | 7,233 |
| 1890 | 6,472 |

### MISCELLANEOUS.

### TABLE 10.

### IMPORTS OF SPELTER.

| Fiscal Year. | Cwts. | Value. |
|---|---|---|
| 1880 | 1,073 | $ 5,310 |
| 1881 | 2,904 | 12,276 |
| 1882 | 1,654 | 7,779 |
| 1883 | 1,274 | 5,196 |
| 1884 | 2,239 | 10,417 |
| 1885 | 3,325 | 10,875 |
| 1886 | 5,432 | 18,238 |
| 1887 | 6,908 | 25,007 |
| 1888 | 7,772 | 29,762 |
| 1889 | 8,750 | 37,403 |
| 1890 | 14,570 | 71,122 |

## NATURAL GAS.*

Ontario.

Provincial Natural Gas and Fuel Co.

Successful operations were carried on in only two counties during the ar 1890, namely, those of Essex and Welland, in Ontario, in the former which and in the neighbourhood of Sherks Station the Provincial itural Gas and Fuel Company have finished their series of 13 wells, m all of which, with one exception, heavy flows of gas were obtained.

This company has now from its producing wells a daily flow of gas uivalent to 30,895,000 cubic feet per day, as follows :—

| | |
|---|---|
| No. 1 | 2,050,000 |
| " 2 | 375,000 |
| " 3 | 600,000 |
| " 4 | 2,200,000 |
| " 5 | 8,500,000 |
| " 6 | 70,000 |
| " 7 | 3,000,000 |
| " 8 | Abandoned |
| " 9 | 3,500,000 |
| " 10 | 4,500,000 |
| " 11 | 300,000 |
| " 12 | 5,500,000 |
| " 13 | 300,000 |
| | 30,895,000 |

Pipe line to Buffalo.

A pipe line connection was being made with the city of Buffalo during latter part of the year, and it was expected that during the spring 891 that city would be largely supplied with gas from this Canadian d.

As an experiment the Provincial Company have sunk a new well, No. to the Trenton limestone, to test the gas-producing properties of that mation. The effort was not, however, crowned with success, as the estones were found to be quite barren at that point.

This well is useful, however, in defining somewhat accurately the th-east boundary of the gas-bearing area, the location of the well ng lot 6, concession XV, township of Bertie. The usual gas-bearing izon was struck at 762 feet and was found to be quite barren, though all quantities of gas were found in the red sandstone overlying these ls.

Other operators have been busy throughout this county, notably the ssrs. Cronmiller and White, John Roeb, Messrs. Carroll Bros., Edward ar and — Hopkins. The well sunk by Messrs. Cronmiller and White

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A very detailed report on the oil and gas wells of Ontario by Mr. H. P. Brumell is now rly completed and will shortly be published by the Geological Survey. It will give the est information regarding distribution and operations in search of gas in that province.

is on lot 29, concession I, township of Humberstone, and attai depth of 800 feet, gas to the extent of 6,000 cubic feet only being i at 675 feet.

Mr. John Reeb's well is situated on lot 6, con. I, township of W fleet, and was sunk to a depth of 820 feet, wherein, at a depth o feet, gas, having a measured daily flow of 400,000 cubic feet, was obta

Messrs. Carroll Bros. drilled on lot 4, con. I, Humberstone town and obtained gas at 883 feet, the depth of the well being 917 fee the flow of gas 990,000 cubic feet per day.

The Near and Hopkins wells each afford about 400,000 cubic fe gas per day, and are on adjoining lots, the former being located o 29, con. II, Humberstone township, while the Hopkins well is o 28 of the same concession.

In all of the wells drilled in the county of Welland the gas, w obtained, is found in a white friable sandstone, near the summit of Medina formation, according to the following record, which is th No. 1 well belonging to the Provincial Company:—

Record of No. 1 well.

| Character of Beds. | Thickness. | Formation. |
|---|---|---|
| Surface deposits | 2 feet. | Drift. |
| Dark grey limestone | 25 " | Corniferous. |
| Drab and grey dolomites, black shales and gypsum | 390 " | Onondaga. |
| Grey dolomite passing into brown | 240 " | Guelph and Niagara. |
| Black shales | 50 " | Niagara. |
| White crystalline dolomite, grey towards bottom | 30 " | Clinton. |
| Red sandstone | 55 " | Medina. |
| Red shale | 10 " | |
| Blue shale | 5 " | |
| White sandstone | 5 " | |
| Blue shale | 20 " | |
| White sandstone | 15 " | Gas horizon. |

Lincoln County.

In the adjoining county, Lincoln, no further operations were under taken, the ill success of efforts of previous years acting as a stron deterrent upon any further expenditure of money.

Wentworth County.

county, adjoining Lincoln, to the west, this has, how- e case, as several attempts to find gas in the neighbour- without success.

Perth County.

ty a boring was made during the year by the Stratford npany, wherein a depth of 2,386 feet was attained with- gas or oil. The Trenton limestone, in which it was uld be obtained, was struck at 2,360 feet, and was found a heavy salt water seam being opened at 2,384 feet. ed off, and the well at 2,386 feet was abandoned.

Kent County.

ity Messrs. Walker & Sons have drilled two wells, r, obtaining gas.

drilled on lot 10, concession XI, township of Oxford, ne "Ravey" well, the following record was obtained tesy of the driller, Mr. J. S. Hyland:—

| | Feet. |
|---|---|
| | 160 |
| | 81 |
| te | 70 |
| , grey | 90 |
| pink | 154 |
| , (?) pure white | 30 |
| grey | 45 |
| , grey | 285 |
| (?), fine | 85 |
| al depth | 1,000 |

on lot 23, con. XIV of the same township, and known well, was not finished at the time of my visit to the dis- 500 feet in depth, of which the following was the

| | Feet. |
|---|---|
| | 240 |
| | 10 |
| pink and grey | 140 |
| white | 20 |
| (?), fine grey | 30 |
| and limestone, grey and white | 60 |

hese two wells was gas obtained, though oil in small ted at 470 and 410 feet, respectively.

y, in addition to the work done by Messrs. Walker & above, a certain amount of work has been carried on, notably the well sunk by the Citizens' Gas Company of Blenheim, where in a boring 900 feet deep small flows of gas were obtained at 700 and 800 feet.

Essex County.

In Essex county extensive drilling operations were in progress at various points, more especially in the district between Essex Centre, Harrow and Leamington. At Essex Centre the Central Gas and Oil Company of that place have finished a well 1,200 feet in depth without, however, any economic result, as neither gas nor oil were obtained. The Citizens' Gas, Oil and Piping Company, of Kingsville, during the year drilled on the road allowance, west of the well known as "Coste No. 1," where a daily flow of gas amounting to over 7,000,000 cubic feet per day was obtained; this gas is now being utilized in lighting the streets of Kingsville, to which town it has been piped. The drilling of this well was the cause of considerable litigation between the owners and the Ontario Natural Gas and Fuel Company, the owners of "Coste No. 1." The result of the suit was, however, in favour of the former company, the injunction given at the instance of the latter not being sustained.

The Union Gas Company have, it is understood, undertaken operations in the county, in that part between "The Marsh" and Essex Centre, with what result, however, we are unacquainted. Various other operators have been working throughout the county, but owing to lack of time it was found impossible to visit and ascertain the result and extent of their operations.

Outside the foregoing but little work has been done throughout Ontario in the search for gas, though that product is being found, in small quantities as heretofore, in the petroleum wells which are constantly being sunk in Enniskillen township.

Quebec.

In the Province of Quebec no active operations were undertaken during 1890, though small finds of gas were reported during the year, notably from the area covered by the drift deposits to the south and south-east of the River St. Lawrence. The gas was in all instances obtained in wells sunk or bored for water, and flowed from the sands and gravel underlying the clay deposits. The flows were small.

Regarding the rest of the Dominion there is nothing of importance to report, nor have any boring operations in search of gas been undertaken.

Available production of Ontario.

In January, 1891, there was in Ontario an available daily flow of gas of over 50,000,000 cubic feet, very little of which was at that time being put to practical use.

## NICKEL.

Sudbury District.

The chief producing district of the Dominion, so far of the ores of this metal, has its centre at Sudbury, at the junction of the Canadian Pacific Railway main line and the Algoma branch.

The discoveries of deposits of nickeliferous pyrrhotite in this district since the inception of prospecting in 1883 have been very numerous. They occur in a belt of country, running about E.N.E. and W.S.W. from Sudbury village, which is about four or five miles wide. It extends from the shores of Wahnapitae Lake, some fifteen miles east of Sudbury, and has been proved nickeliferous as far as Nelson, on the Algoma branch, making a total distance of some fifty miles. Up to the end of the year some twenty well-authenticated deposits had been located, not to mention many others of which little is as yet known.

About thirty miles north-west of Sudbury, on the main line of the Canadian Pacific Railway, is the Straight Lake area, with dimensions about six miles by two. It is in the vicinity of the station of that name, and contains several promising deposits.

Operators.

Apart from prospecting work, the activity this year has been confined to the operations of the three chief companies, viz. :—The Canadian Copper Company, with headquarters at Cleveland, Ohio, and operating the "Copper Cliff," "Stobie" and "Evans" mines. The Dominion Mineral Company, with headquarters in Montreal, and operating the "Dominion" mine, and Messrs. H. H. Vivian & Co., of Swansea, England, operating the "Murray" mine.

All these mines are within a radius of about six miles of Sudbury. The "Copper Cliff" and "Evans," on the Algoma branch, and the "Murray" on the main line, west of the villlage, whilst the "Stobie" and "Dominion" find outlet by means of a short branch line. These mines give employment directly to some 780 men.

A description of the mode of occurrence of these deposits and of the processes of extraction adopted cannot be better given than it is in the paper written by Mr. A. E. Barlow and given below. His official connection with the staff of the Geological Survey as well as with the work undertaken by the Department in the study of the district enables him to speak with special authority on its geological features. Further details concerning the geology metallurgical processes, &c., will be found, by reference to the article on nickel in the volume on the Mineral Resources of the United States for 1888, issued by the Geological Survey of that country; to a paper on the Sudbury ore deposits by E.D. Peters, formerly manager for the Canada Copper Co., in vol. XVIII, Trans. American Inst. Mining Engineers; and to a paper by Dr. R. Bell entitled "The Nickel and Copper Deposits of Sudbury district, Canada." Transactions Geological Society of America, Vol. 2, pp. 125.140.

### ON THE NICKEL AND COPPER DEPOSITS OF SUDBURY, ONT.*

*By Alfred E. Barlow, M.A., Geological Survey Department.*

Geological associations of deposits.

"The presence of large deposits of nickel and copper in the district of Algoma, Ontario, has of late years attracted world wide attention, in the first place on account of their immense and apparently inexhaustible character, but latterly because of the proposed application of nickel in alloy with steel to improve the quality of the latter. The existence of workable deposits of copper in this region was a fact that had long been known, and as far back as 1770 a company had been formed and attempts made to mine this metal, but the difficulty of procuring and maintaining miners at so great a distance from any centre of civilization, the remoteness of any market for the ore, as well as the absence of facilities for transportation, rendered these first attempts abortive. However, in 1846, owing to the activity in prospecting and locating mineral lands on the southern shore of Lake Superior, and a favourable report by Mr. W. E. Logan, then newly appointed Provincial Geologist, some enterprising Canadians banded themselves together into two associations called "The Montreal Mining Company," and the "Upper Canada Mining Company." The former company having purchased, amongst others, what was then known as "The Bruce mines" location, and on account of the richness of the deposit decided to commence active work at this locality, while the Upper Canada Company proceeded to develop and work what was known as the "Wallace mine," at the mouth of the Whitefish River. The Montreal Mining Company continued their operations from 1846 to 1865, when, from a variety of causes, the work proving unremunerative, they sold out the whole of their claim to the "West Canada Mining Company," who had previously leased and worked the western half of the location under the name of the Wellington mine. This company continued working till 1876 when, owing to unsatisfactory results, work was suspended and has not been resumed since. The Wallace mine was chosen on account of its promising character and proximity to civilization, and is chiefly remarkable as having been the first place in Canada in which the presence of nickel had been detected.

Wallace Mine.

"According to Mr. Alex. Murray, of the Geological Survey of Canada, who made an examination of the location in 1848, 'No true vein can be discovered, but the ore occurs at the contact of quartzose and chloritic slates with diorite, as bunches and strings of pyritous matter, inter-

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*Read before the Ottawa Field Naturalist Club.

Analyses of ore.

laminated irregularly with the slates, and distributed in specks and patches in the diorite. Abundant evidence of disturbance is displayed in irregularities of dip and intrusion of the diorite. The material collected for assay was chosen as free as possible from copper pyrites, but nearly two-fifths of the specimen consisted of earthy materials, which might readily be separated by dressing.' (See Report Geological Survey of Canada, 1848–49, p. 42—45). Dr. T. Sterry Hunt, in his report on this ore, says that "the specimen is a steel grey arseniuret, the species not determined, with white iron pyrites and probably some arsenical sulphuret of iron.' The mass, weighing 45 oz., was reduced to powder and submitted to analysis, with the following results:—

| | |
|---|---|
| Iron | 24·78 |
| Nickel, with trace of cobalt | 8·26 |
| Arsenic | 3·57 |
| Sulphur | 22·63 |
| Copper | ·06 |
| Earthy materials | 40·01 |
| | 99·31 |

"In the process of washing the ore, the earthy parts being removed by washing, the composition of the ore in 100 parts, as deduced by calculation from the above, would be—

| | |
|---|---|
| Iron | 41·79 |
| Nickel and cobalt | 13·93 |
| Arsenic | 6·02 |
| Sulphur | 38·16 |
| Copper | ·10 |

"From the small proportion of arsenic the nickel must, in part at least, be present in a state of sulphuret, a fact which is, indeed, made evident by the spontaneous oxidation of the ore. The nickel from this source contained about three parts in a thousand of cobalt. In conclusion, he remarks that in the same bands of rocks we may detect the presence of nickel and cobalt, a prophecy which has since been amply verified.

"A mass of copper pyrites from the same mine weighing 9½ lbs. was also assayed, which yielded 11·6 per cent of metallic copper. Acting on these and other favourable reports, the company began to sink shafts to test the extent and the quality of the ore, and one of these shafts at least attained a depth of 10 or 15 fathoms. Work was carried on energetically for some years, but the enterprise was finally abandoned, as the quantity of ore did not seem sufficient to justify further expenditure.

"In his report for 1856, Mr. Alex. Murray (see Report Geological Survey of Canada, 1853-56, p. 180) mentions the occurrence of a 'dingy

History of discovery.

green magnetic trap' associated with red syenite in the north-west corner of the township of Waters on Salter's meridian line. Specimens of this trap were given to Dr. Hunt for analysis, and the result of his investigation showed that it contained magnetic iron ore and magnetic iron pyrites, generally distributed through the rock, the former in very small grains; titaniferous iron was found associated with the magnetic ore and a small quantity of nickel and copper. The variation of the magnetic needle near this mass was from ten to fifteen degrees west of the true meridian. It can thus be seen that even at this early period of its history the officers of the Geological Survey were aware of the existence of nickel in this region, and had pointed out the probability that workable deposits would be found. Years passed by and the inaccessible nature of the country deterred prospectors from making very detailed exploration or examination, so that it was not till 1883, when the Canadian Pacific Railway was in course of construction, that the first discoveries of any consequence were made, since which time the whole belt of the Huronian district has been overrun with eager prospectors and miners. A not infrequent accident in newly settled districts led to the first important discovery. Judge McNaughton, stipendiary magistrate at Sudbury, had been lost in the woods to the west of that village, and diligent search was at once instituted for him. A party consisting of Dr. Howey and two others found the judge seated on the small eminence which then marked the site of what is now known as the "Murray mine." Early in 1884 the Canadian Pacific Railway made a cutting for their main line through this small hill, about 3½ miles north-west of Sudbury, and on July 12th of the same year Dr. Selwyn made a careful examination of the location and pronounced the lode to be one of the most promising he had yet seen in Canada. Other discoveries soon followed, and the McConnell, Lady Macdonald, Stobie, Blezard, Copper Cliff and Evans mines were all located. At first the wildest notions were entertained as to the extent of these deposits, and the most exaggerated reports circulated as to their value. It was even confidently asserted that these were immensely important discoveries, and would revolutionize the whole copper trade and render other mines then in operation quite unremunerative. Rounded hills of gossan, indicating the presence of the more solid and unaltered ore beneath, occur at intervals for miles in a southwesterly direction, conforming rudely to the strike of the rocks in the vicinity. This circumstance is all that seems to have justified the early discoverers in describing the deposits as veritable mountains of solid ore, many miles in extent and hundreds of feet thick. Closer investigation revealed the fact that these surface gossans everywhere indicate the presence of the ore beneath, and that the ore itself occurs in lenticular masses, entirely

History of discovery and development.

parated from one another, whose longer axes correspond with the rike of the enclosing rock. This gossan has resulted, as is usual, from e formation of peroxide and hydrated peroxide of iron, due to the composition of the pyrrhotite and chalcopyrite which gives a prevailg red or reddish brown colour to the upper portion of the deposit. iis covering of iron oxide is sometimes as much as six feet in depth. though usually it is only two or three feet, gradually merging itself to the unaltered ore beneath. During the last few years prospectors ve not been idle, and at the present time about twenty very promising posits of these ores have been "located" and/ "taken up." The cAllister mine, now called the Lady Macdonald mine, was the first operty on which any work was done in the summer of 1885, although er in the fall the Evans mine was opened up and some preliminary sts made. On 6th January, 1886, the Canadian Copper Company s formed with a subscribed and paid up capital of $2,000,000, which s afterwards increased to $2,500,000, to operate the Copper Cliff, obie and Evans mines.

"On May 1st, 1886, work was started in earnest at the Copper Cliff ine, and later on in the same year both the Stobie and Evans mines ere opened up, and with the exception of a few months last summer, hen, on account of some difference with the Canadian Pacific Railway, e Stobie was shut down, these three mines have been in active operaon ever since. The chief business of the Canadian Copper Company done at Copper Cliff, for here they have prepared a well equipped ast yard, two smelting furnaces, laboratory and offices, and other ings requisite for carrying on this mining on an extensive scale. The tobie and Evans mines are provided with excellent rock houses, but all heir ore is brought by branch railways to Copper Cliff to be roasted nd smelted. In 1889 the Dominion Mineral Company was formed to erate the Blezard mine, and later on they purchased the Worthington ine from the original owners. During the past summer this company ve had their smelter in operation, and both their mines are being ergetically developed. During the summer of 1889 the Murray mine s prospected under bond by Messrs. Henry H. Vivian & Co., Swansea, gland, and in October of the same year they purchased it. About end of last September, everything being ready, the smelter "was wn in" and set to work on some ore which had been previously sted. All three companies are now prosecuting the work vigourously, the output of these mines has already reached very large proporns. The whole district has been prospected, and I think that a very nservative estimate would now place the number of promising deposits twenty.

Geological conditions of occurrence of ore bodies.

"The Huronian system in which these ore deposits occur may be regarded as the oldest series of sedimentary strata of which we have at present any certain knowledge. Amongst the more important of these rocks may be mentioned quartzites, greywackes, conglomerates, slates, evenly laminated gneisses, felsites, hydromica, chloritic, epidotic, hornblendic and micaceous schists and narrow bands of cherty limestone. Most of these clastic rocks have been derived from the waste of older felspathic material, and hitherto it has been most generally supposed and stated that the Laurentian gneiss was the source from which the sediments had been derived. The Huronian conglomerates, however, hold no pebbles that are undeniably referable to the Laurentian, and the origin of the syenitic, quarzose and jaspery pebbles is still a matter of doubt. The microscope can throw no certain light on the original character of some of these rocks, for very often metamorphism and recrystallization has gone on to such an extent that the former structure has been either partially or completely obliterated. A close study of these uncertain rocks in the field, aided by the use of the microscope in the laboratory, will eventually enable us to assign them their proper place. We have thus numerous sedimentary rocks showing the various stages of this metamorphism, from the typical sandstone or greywacke, composed of well-rounded grains of quartz and felspar, to the compact felsite, which contains no trace of its original clastic structure. Associated with these sedimentary strata are certain undoubted eruptive and irruptive rocks, among which may be mentioned many varieties of diabase, diorite and gabbro. Besides these igneous rocks, there are some granites and gneisses concerning whose origin many are in doubt. After a close and careful study of these rocks, which have usually been classified as Laurentian, and their relations with the true Huronian stratified deposits, I have been fully convinced of their irruptive nature. These granites and gneisses probably represent the original crust of the earth which has undergone refusion, and was in a molten or plastic condition at a period subsequent to the hardening of the Huronian sediments. The earth gradually cooling from a state of original incandescence, had reached that stage in the process when it admitted of being surrounded by an ocean nearly, if not quite, universal. Then began that tearing down and building up which has since gone on in forming the sediments which subsequently hardened into rocks. The first formed crust was necessarily thin and weak, and it is therefore not surprising that there were frequent irruptions, accompanied by the fusion of the lower portion at least of the first formed deposits.

"It is unnecessary here to go into all the facts of the case, as my views have already been stated at some length in a paper read before

Geological conditions of occurrence of ore bodies.

his club on 27th February of last year. Suffice it to say that the fuller xaminations of last summer have served to further strengthen these iews. Both clastic eruptive and irruptive rocks have been subjected to ntense pressure, as evidenced by the extensive cataclastic structure which as been developed in both series of rocks. Frequently the rocks show pyroclastic origin, and volcanic tuffs and breccias are very commonly net with. The relations of the diabase or basic irruptive rocks with the urrounding sedimentary strata was closely examined in a large number of nstances, and revealed the fact that the diabase is apparently of later age, s it breaks through and alters the bedded Huronian. The occurrence f these masses of diabase with a surrounding breccia or agglomerate n many cases would seem to point to the fact that they are the bases of Iuronian volcanoes, which continued in action after the latest sediment ad been deposited. Some of these diabasic masses send out dykes hich ramify through and alter the surrounding strata, these dykes requently containing fragments of highly metamorphosed Huronian uartzite. These masses are usually lenticular, although occasionally udely circular or oval in outline, and their longer axes correspond in eneral with the strike of the enclosing rock. They vary in breadth rom a few chains to half a mile, or even more, and frequently extend r miles in length. The origin of the nickel and copper is closely con-ected with this diabase or gabbro, and the formation of the fissures ontaining these ores was no doubt due to the disruptive forces of the ntrusion, and the contraction caused by the subsequent cooling of the gneous rock matter. These fissures were necessarily most frequently ormed along the line of contact with the cooler sedimentary strata, although in certain cases they were formed in the midst of the igneous mass itself. In nearly every case, therefore, the deposits of nickel and copper occur close to the contact of the diabase with the stratified rocks, although in a few cases they are found in the diabase near its junction with granite or micropegmatite. Another proof of the common genesis of these ores and the enclosing diabase is that the diabase itself commonly contains these sulphides disseminated through its mass, these impregnations occasionally forming such considerable and rich deposits as to be workable.

Characteristics of ore-bodies.

" All geologists who have examined these deposits agree that they are ot true fissure veins, and although at times a certain sloping surface is btained which seems to have a uniform inclination, yet it seems certain hat there are no regular walls in the miner's sense of the term, and at oth sides of the deposits the enclosing rock is impregnated more or less ith the pyritous matter. Though mining is thus rendered somewhat ifficult and uncertain on account of the absence of the walls and irregu-

Characteristics of ore bodies.

larity in the distribution of the ore, so that there is no means of knowing in what direction to drive the levels, this uncertainty is more than compensated by the extent and massiveness of the deposit when found. The ore bodies like the masses of diabase with which they are so intimately associated are lens or pod-shaped and 'pinch out' in both directions. This structure is also characteristic of their downward extension, and the deposits have been very truly likened to a string of sausages, so that when one lenticular body of ore gives out another commences close at hand, which in its turn gives place to another, and though at the Copper Cliff they are down about 600 feet on a slope of 45°, the quantity and quality of the ore shows no diminution. I have occasionally found true veins of quartz holding this pyrrhotite, but such evidences of secondary action are extremely rare and proves nothing in regard to the origin of the more massive deposits. The ores and the associated diabase were therefore in all probability simultaneously introduced in a molten condition, the particles of pyritous matter aggregating themselves together in obedience to the law of mutual attraction. The ore bodies were, therefore, not contemporaneous with the stratified Huronian, although there is nothing to prove that they do not belong to the close of the Huronian period. Mr. Ferrier, of the Geological Survey, has noticed the occurrence of this nickeliferous pyrrhotite in a specimen of chloritic schist and gneissic granite, which had been taken to show the contact between the two rocks.

"The ore itself is a mixture of pyrrhotite, a monosulphide of iron ($Fe_7 S_8$) and chalcopyrite, a sulphide of copper and iron ($Cu Fe S_2$). The two minerals are not so intimately commingled as to form a perfect homogeneous mass, but one may be described as occurring in pockets, spots, bunches or threads in the other. The chalcopyrite is not so closely intermixed with the pyrrhotite, but isolates itself rather in spots and patches enclosed by massive pyrrhotite, so that it is not hard to separate considerable masses of chalcopyrite that will assay over 30 per cent of copper, or pyrrhotite that will only show traces of that metal. In practice, however, careful examination and trial have proved that the two minerals are too intimately associated to make sorting by hand at all practicable, and the pyrrhotite is very often so feebly magnetic as to preclude the possibility of separation by magnetism. Although the chalcopyrite seldom occurs free from the pyrrhotite, large and massive deposits of the latter occur comparatively free from copper. In this connection Dr. Peters mentions a stope which, having furnished about 2,000 tons of pyrrhotite, gave place, just before the end boundaries were reached, to a deposit which afforded nearly 20 tons of almost pure chalcopyrite. In some instances these ore bodies show a brecciated

Characteristics of ore bodies.

character, large angular or partially rounded boulders or 'horses' of almost barren rock being mingled with the ore, which seem to evidence the disruptive force of the intrusive mass, while in others, as at the Worthington mine, the diabase in which the ore occurs has developed a concretionary structure while cooling, and large irregularly rounded concretions, which, on weathering, peel off in concentric layers, are cemented together, so to speak, by a very pure chalcopyrite and highly nickeliferous pyrrhotite. The concretions themselves usually contain more or less pyritous matter disseminated through them, but are usually cast aside as too barren for the roast heap. The pyrrhotite varies in colour from steel-grey to bronze-yellow, and the chalcopyrite is the usual brass or deep yellow colour. Both tarnish readily, and very beautiful iridescent specimens can be easily obtained from the ore heap or scattered around the works. These sulphides, therefore, may be said to occur in three distinct ways—

"1st. As contact deposits of pyrrhotite and chalcopyrite situated between the clastic rocks, such as felsites, quartzites, etc., and igneous diabase or gabbro, or between these latter and granite or micropegmatite. Good examples of the former are furnished by the Evans, Stobie and Copper Cliff, while the Murray mine may be cited as illustrating the latter.

"2nd. As impregnations of these minerals through the diabase or gabbro, which are sometimes so rich and considerable as to form workable deposits. These sulphides are in no case present as disseminations through the clastic rocks very distant from the diabase or gabbro, which seems clear evidence that they have been brought up by the latter.

"3rd. As segregated veins which may have been filled subsequently to the irruption which brought up the more massive deposits. These veins are not very common, although certain portions of the more massive deposits may have been dissolved out and re-deposited along certain faults and fissures.

Composition of ore.

"The composition of the ore varies according to the preponderance of either the pyrrhotite or chalcopyrite in the specimen examined. The pyrrhotite may be said roughly to be composed of 40 per cent sulphur and 60 per cent iron, with a varying proportion of the iron replaced by nickel, while the chalcopyrite contains 35 per cent sulphur, 35 per cent copper and 30 per cent iron. The mines of the Canadian Copper Company, as the name of the company indicates, were first opened for their copper contents, and it was not until considerable work had been done that nickel was discovered to be present in the ore. A large shipment of ore had been made to New York, and a chemist there who was making a volumetric determination of the copper contents by the Potassium Cyanide process, was struck by the great variation in his results, which led him to make a more minute examination of the ore, when he found that nickel was present. The ore has now become of more value on account of its nickel than its copper contents, and Dr. Peters himself greatly doubted if the mines would pay to work for copper alone. The percentage of nickel and copper varies greatly, as might be expected, but assays of nine samples from the different mines of the Canadian Copper Company, made in November, 1888, will show the usual percentage of these metals. These assays were made by Mr. Francis L. Sperry, and show a range in the percentage of nickel from 1·12 per cent to 4·21 per cent with an average of 2·38 per cent., while the copper varied from 4·03 per cent to 9·98 per cent, with an average of 6·44 per cent. A minute proportion of cobalt also occurs in the pyrrhotite usually about $\frac{1}{50}$th as much as the nickel present. Mr. G. C. Hoffman assayed four samples from this district which I collected last summer, and these showed the nickel contents to vary from 1·95 per cent. to 3·10 per cent with an average of 2·25 per cent. Three of these samples contained traces of cobalt, which are included in the above percentage of nickel. The nickel is usually spoken of as replacing an equal quantity of iron in the pyrrhotite, but the discovery of undoubted crystals of millerite or sulphide of nickel 150 feet below the surface at Copper Cliff Mine, as well as the more recent recognition of polydymite, a ferriferous sulphide of nickel, at the Vermilion Mine, in the township of Denison, seems to justify the assumption that in the more highly nickeliferous deposits of the region at least, the nickel is also present as a sulphide, disseminated through the ore mass like the iron and copper.

"This view is also borne out by Dr. Hunt's analysis of the ore of the old Wallace mine which seems precisely analogous to some of the richer deposits nearer the Canadian Pacific Railway. Traces of gold and silver, as also platinum are also usually found in these ores, and in this connection it was thought advisable to call your attention to the detection of what Messrs. Clarke & Catlett call a 'platiniferous nickel ore from Canada.' They say (see article xxxix, page 372, *American Journal of Science*, 1889.) During the autumn of 1888 we received, through two different channels, samples of nickel ores taken from the mines of the Canadian Copper Company at Sudbury, Ont. From one source we obtained two masses of sulphides to be examined for nickel and copper, from the other came similar sulphides together with a series of soil and gravel-like material (gossan), seven samples in all. In the latter case an examination for platinum was requested, and in five of the samples abovementioned it was found the gravel yielded 74·85 ozs. of metals of the platinum group to the ton of 2,000 lbs. The sulphide ores submitted to us from Sudbury were all of a similar character. They consisted of mixed masses in which a grey readily-tarnishing substance was predominant with some chalcopyrite, possibly some pyrite and a very little quartz. Two samples were examined in mass: one gave 31·41 per cent nickel with a little copper, and the other gave 35·39 per cent nickel and 5·2 per cent copper. The nickel mineral itself proved to be a sulphide of nickel and iron, and as ores of that composition are not common, it was thought advisable to examine the substance further. It is steel-grey massive and exceedingly alterable in the air with a specific gravity of 4·5. An analysis of carefully selected material gave:—

| | |
|---|---|
| Nickel | 41·96 |
| Iron | 15·57 |
| Silica | 1·02 |
| Copper | ·62 |
| Sulphur | 40·80 |

"These figures give approximately the formula $Ni_3\ Fe\ S_5$. Neither cobalt nor arsenic could be detected. If we deduct silica together with the copper reckoned as admixed chalcopyrite and re-calculate the remainder of the analysis to 100 per cent we get the following figures:—

| | |
|---|---|
| Nickel | 43·18 |
| Iron | 15·47 |
| Sulphur | 41·35 |

"In short the mineral has the composition of $Ni_4\ S_5$ with about $\frac{1}{4}$th of the nickel replaced by iron, which seems to agree with Laspeyres polydymite of which it is doubtless a ferriferous variety. Probably in most cases the nickeliferous constituent of pyrrhotite is millerite, but other sulphides like polydymite may occur too. The polydymite which was selected for the above analysis came from the mass in which the average of 35·39 per cent nickel and 5·20 per cent copper had previously been found.

Platianum assays.

"The mass weighed several kilograms and was remarkably free from quartz. The same mass, with two smaller pieces resembling it, were also examined for platinum. The results were as follows, "A" representing the large mass in which the polydymite was determined:—

| | | | | | |
|---|---|---|---|---|---|
| A | 2·55 oz. | platinum | per ton, or | ·0087 | per cent. |
| B | 1·8 oz. | do | do | ·0060 | do |
| C | 7 oz. | do | do | ·024 | do |

"Probably the platinum exists in the ore as sperrylite, although this point was not proved. The amount of platinum in the mass most thoroughly examined would require to form sperrylite only about ·007 per cent of arsenic, which is too small a quantity for detection b ordinary analysis. That platinum should exist in appreciable quantitie in an ore of such a character is something quite extraordinary, bu whether it could be profitably extracted is an open question.

Sperrylite.

Sperrylite was first found at the Vermilion mine in the gossan or loos material, and was named after Mr. Francis L. Sperry, of the C. C. C., by Messrs. Horace L. Wells and S. L. Penfield, of the Sheffield Scientifi School, who examined and described this new species. It is isometric; simple cubes are common, octahedrons are exceptional, while the majority of the crystals are combinations of the cube and octahedron. H.—Between six and seven, as it scratches felspar but not quartz. The crystals have no distinct cleavage, but are very brittle and break with an irregular, probably conchoidal fracture. The chemical composition, according to the mean of two analyses was as follows :—

| | |
|---|---|
| Arsenic | 40·98 |
| Antimony | ·50 |
| Platinum | 52·57 |
| Rhodium | ·72 |
| Palladium | trace. |
| Cassiterite or oxide of tin | 4·62 |

"The composition is therefore represented by the formula $Pt\,As_2$, a small portion of the platinum being replaced respectively by rhodium and antimony. The colour of the mineral was nearly tin white or about the same as metallic platinum. The fine powder is black. Nearly all the grains showed extremely brilliant crystal faces, though most of the crystals were fragmentary in size they were usually $\frac{1}{50}$ — $\frac{1}{500}$th of an inch in diameter. Sp. Gr. 10·602.

Metallurgical treatment.

*Roasting.*—"The metallurgical treatment of this ore commences at the roast yard whither it is conveyed, and, being piled in convenient heaps on previously laid cordwood, is exposed at high temperatures without fusion, or, at most, incipient fusion, to the action of a current of air. The objects of this roasting are, 1st, an oxidation of the iron, and, incidentally, of the sulphur, as complete as is possible without involving an undue loss of copper in the slags of the following smelting, and, 2nd, the expulsion of arsenic, if there is any present. If the oxidation be very imperfect the resulting matte will contain so much iron that its bringing forward will be unduly costly, while, if the oxidation be too thorough, an undue loss of metal will occur on smelting the roasted ore. At Copper Cliff the Canadian Copper Company have spared neither trouble nor expense in the construction and equipment of their roast yard. The natural rough and uneven surface has been cleared and levelled, and the whole given a gentle slope, which, with carefully made drains, serves to remove at once any rain or surface water. These precautions have to be taken to 'ent loss of copper as soluble sulphate of copper, which is liable to rashed out by the rain.

**Roasting.**

At the Murray mine a large shed has been erected to roast ore during winter months, with openings in the roof to allow of the escape of hurous fumes, but during last summer they had no regular roast l, and the few heaps burnt could only be placed where the surface of ground would permit. This was also the case at the Blezard and rthington mines, and the mechanical loss alone from this carelessness ıt have been of considerable moment. The shaft of the Copper Cliff e, on an incline of 45°, has reached already a depth of nearly 600 . It is provided with a double skip road, the skips dumping automa-lly at the mouth of the breaker in the top of the rock house. Here the is sledged to a proper size for the 15 x 9 in. Blake crusher set to about nches, which has a capacity of nearly 20 tons an hour. It is then passed ongh a revolving screen where it is sized into three classes for the ceeding operation of roasting. The coarse size passes a 4-inch ring, the dium or ragging a 1¾-inch ring, while the fines pass through one ¾ of inch in diameter. Each of these sizes falls into a separate bin under ich a car runs. Thus the ore is loaded automatically into cars ding 1½ tons, whence it is transported to the upper story of ore shed. There it falls into a series of bins from which it is led by means of inclined steel shutes into the cars and taken a rather steep grade to a high trestle which extends the whole length the roast yard. The only wood that can be obtained is dead pine, a d deal of the surrounding district having been burnt over about 20 rs ago. This can be procured very cheaply, and although it does roast the ores as thoroughly as hard wood, it makes very fair and nomical fuel, and serves on account of its short fierce heat to ignite pile, and this once started continues burning on account of its phur contents. These piles are built as follows :—The place selected irst covered with about six inches of fine ore distributed as evenly as sible over the clay soil. Sticks of cordwood of nearly uniform size ıuld be placed side by side across both sides and ends of the rect-;ular area. The whole interior of this can be filled in with old mps, roots, ties or cordwood, but in such a way as to form a level solid bed for the ore to rest on. Over all this is placed small wood chips to fill up all interstices, care being taken to provide small als filled with kindlings at intervals of 8 to 10 feet leading from the er air to the chimneys along the centre of the heap. These chimneys ich assist in rapidly and certainly kindling the whole heap are usually lt of four sticks or old boards, so fixed together as to leave an opening communicating below with the draught passages. Five or six of

Roasting.

these chimneys suffice for each pile, and they should project 2 feet above the upper surface of the heap, so that no pieces of ore could fall into the flue opening. The coarsest class of ore is first thrown on, then the ragging or medium, on top of which is scattered a layer of rotten wood or chips, and lastly the whole heap is covered over with fines till it reaches a height of about 6 feet. The whole structure should then form a shapely rectangular pile with sharp corners and as steeply sloping sides as the ore will naturally lie on without rolling (about 45°). Only a portion of the fine ore is put on at first, the rest being shovelled on after the fire is fairly started. The best way to light the pile is to place a quantity of ignited cotton waste saturated with coal oil down each of the chimneys. About twelve hours after firing the whole heap should be pouring forth dense yellow fumes of sulphurous acid. Great attention is at first paid to the pile to prevent undue local heating which frequently causes partial fusion of the ore, and this can at once be prevented by covering the place with more fines. This heap should then burn from 50 to 70 days when the outer covering of raw or partially roasted ore is removed, and the remainder of the heap conveyed a few yards in wheelbarrows to a sunken railroad which runs alongside of the roast-yard. When filled, the cars are pushed up another steep grade along a track running over the bins back of the smelter. The sloping sides and corners of a pile are frequently covered with almost raw ore, this evil being often remedied by placing ignited sticks of cordwood around the whole structure, or by building a new pile in the passageway between two others which have been almost burned out, the latter plan adding very materially to the capacity of the roast yard. After this operation the ore is invariably so thoroughly roasted that it is necessary to add from 10 to 25 per cent of raw fine ore during the smelting to prevent the matte from being too rich. Each pile usually contains about 600 tons of ore, and requires 30 cords of wood to roast it. The roast yard at Copper Cliff is nearly half a mile long by 100 feet wide, while each pile occupies a space of 40×80 feet, room being left to get round them, and for drains. The present capacity is about 60,000 tons, which, with a little extra work, could be increased to 90,000 tons. Working full power each roast bed can be used four times a year, counting the time in making, roasting and clearing the beds. The yearly capacity would therefore be 240,000 tons, and by increasing the space, 360,000 tons. The unroasted ore contains from 35 to 40 per cent sulphur, and assays of a large number of samples of the roast heaps have varied from 2½ to 8 per cent of sulphur. One analysis taken at random which may be taken as a fair sample of all the rest, gave 5·40 per cent copper, 2·43 per cent nickel, 7·92 per cent sulphur and 25 per cent iron, lime, magsia, etc., and the residue chiefly hornblende. Up to 1st October, 1890, ,534 tons had been taken to the roast yard.

Smelting.

"*Smelting of the Ore.* There are two smelting furnaces at Copper Cliff, d the building which contains these is 65 feet long by 40 feet wide. irty-five feet of this length is on a level with the ground, while the rest the floor is 8½ feet higher, and it is on this upper flat that the ore and l bins are situated. The daily capacity of each of these furnaces is 125 ns, although one of the furnaces has reduced 187 tons of ore in one day, d the furnace manager says that 135 tons could be reduced without ch forcing. The furnace itself is a steel plate water jacket of the rreshof patent, made in Sherbrooke, P. Q., by the Jenckes Manufac- ring Company. It is nearly oval in form, the longer diameter at the yères being 6 ft. 6 in., while the shorter one is 3 ft. 3 in. There are 2½ in. tuyères through which the blast enters from a Baker's rotary ower under a pressure of about 9 ounces per square inch. It is 9 feet gh from these tuyères to the charging door, and is an unbroken water cket from the cast iron bottom up. It is made of rolled steel with ly a two inch water space, and not a single brick of any description. he well is a circular, cast-iron water jacketed vessel, mounted on four rong wheels for convenience of moving it when repairs are necessary, nd so made that the hole in one side connects with the outlet hole of e furnace, which is also thoroughly protected by water and it is rough this that the matte and slag flow out of the furnace as rapidly s formed. They thus escape the influence of the blast, and prevent hat Vivian calls 'the sole objection to blast furnaces' the so-called ows' or 'salamanders' as great masses of metallic iron which choke p the furnace and tie up large quantities of copper and other metals. he charging door is situated on the upper floor, as also the bins for ast ore and coke. The coke used is from Connellsville, Pa., and is rought by way of the Great Lakes and the Sault Branch of the C.P.R. he charge for the furnace consists of 1,800 or 2,000 lbs. of ore and coke ixed, one ton of coke usually sufficing for eight tons of ore. The ass as it melts gathers at the bottom of the furnace, and flows through e outlet into the well or reservoir, where the heavier and metallic ortions sink to the bottom while the lighter slag remains on the sur ce, running in a continuous stream over the jacketed spout into pots n wheels, which are removed when filled, an empty one always being ady to take the vacant place. The matte is drawn off at intervals of 5 or 20 minutes through a separated bronze water-cooled tap-hole cast- g, near the bottom of the well, and which is filled as usual with a clay lug that can readily be removed with a few blows from a steel bar. he smelting of the ores is greatly facilitated by the basic character of

Smelting.

the accompanying gangue rock, for instead of quartz and acid silicates there is chiefly hornblende and very fusible felspars. This circumstance, as well as a judicious mixture of the different qualities of ore obviates the necessity of any flux, which is a very fortunate circumstance, as limestone is somewhat distant and suitable iron ore difficult to procure. The slag buggies or pots are made as strongly and lightly as possible, are case-hardened and shaped like inverted hollow cones, and before each tap are thickly washed with clay water to prevent the matte from welding to the iron mould. This matte is sampled and weighed and allowed to cool before being dumped from the pots and the slag also is sampled and assayed once every 24 hours, so that an accurate record can be kept of the composition of both. An average of two analyses of this matte in February and March, 1889, will probably give us the usual composition: Copper, 26·91; nickel, 14·14; iron, 31·335; sulphur, 26·95; cobalt, ·935. Mr. F. L. Sperry says that platinum exists in quite appreciable quantities, so that the matte contains some ounces per ton of that rare metal, while gold and silver occur in strong traces. The first blast furnace was started on the 24th December, 1888, and with slight interruptions has been running ever since. The second furnace was built in the summer of 1889, and was started on the 4th of September of the same year. On 1st October, 1890, there was about 6,500 tons of matte, and the ore on the roast beds would produce about 6,000 tons more, containing 922 and 852 tons of nickel respectively, or a total of 1,774 tons of metallic nickel, and 3,362½ tons of metallic copper.

"The average daily output of matte for the month of September, 1890, was 25 tons, but the full capacity of both furnaces would be about 60 tons of matte. If the former average was kept up, the yearly production of matte would reach 9,125 tons, but if the furnaces were run at their full capacity they would average nearly 8½ tons of nickel a day, or nearly 3,066 tons of metallic nickel and 5,913 tons of copper a year. At present the matte is piled in heaps outside of the smelters, and, when wanted to be shipped, is broken up in pieces and placed in old oil barrels, the chinks between the larger pieces being filled with smaller fragments, so that the whole is packed tolerably firm and close. It is then sent to the various refiners in Europe or the United States according to their respective bids. So far no refining works have been built at Sudbury, but the vast quantity of material to treat, the tedious and costly process for the further refining of the ore, consisting as it does of alternate roastings and smeltings, in addition to the great expense incurred at present in shipping the matte to such long distances, seem great incentives to the early erection of refining works, so that the ore could be fully treated on the spot. The proposition to build nickel steel works was lately submitted to the Government by the Canadian Copper Company, and it is to be hoped that some satisfactory arrangement will be arrived at to give a further impetus to our present mining activity in this region.

Markets and uses.

"Nickel is a comparatively new metal for it was not recognized as an element till 1751, when Cronstedt, the Swedish mineralogist, in examining the ores of certain veins in the German copper mines made the discovery of the two new metals, nickel and cobalt, which names he retained as they were in use amongst the miners. Nickel in its pure state is silver white in colour, hard, tough, fusible with difficulty, and is susceptible to magnetism, although not to the same extent as iron. Its use in the industrial arts has rapidly increased since it has been produced in a pure state, as it formerly existed only as an impure alloy, and so could not be so suitable for the purposes for which it is now used. The demand has only grown at a moderate rate as compared with the growth and demand for other useful metals, and a decrease in price from $2.60 per pound in 1876 to the present price, which varies from 50 to 60 cents per pound, seems to have had no very important influence in increasing that demand. The supply of late years has been more than sufficient for the demand and new deposits have always been found in advance of any necessity for their product. The first chief demand for this metal was for making nickel or German silver as a substitute for the more precious metal in making spoons and forks and other ware in general for which silver had been previously used, and its whiteness and the facility with which it received and held the silver, after the process of what is known as electro-plating was introduced, cause it to be still more widely used. It is also made use of to plate iron, zinc, etc., and also in alloy with copper for the manufacture of small coins, which are used so extensively in the United States, Germany, Belgium and other countries. The proposition to use rolled nickel plate as an advance over ordinary tin plate, is one which is receiving attention at present. It has also been recommended for making nickel crucibles to replace those of silver used in chemical manipulations as they would cost less and have the great advantage of melting at a higher temperature.

"Nickel plated kitchen utensils are coming into general use as in Germany, and as it is well known that acids have a more or less solvent action on nickel, an investigation was undertaken which showed that 7½ grains of nickel could be taken into the stomach and repeated for a long time without any noticeably bad effects. There is thus no ground for uneasiness in the use of such utensils, especially if the same precautions are used as in the case of copper vessels, namely, thoroughly cleaning them and avoiding the storing of food in them. The proposi-

Markets and uses.

tion to use nickel in alloy with steel to increase the strength and quality of the latter, will, if carried out, increase the consumption very materially, and all have been eager to know the result of the recent experiments undertaken at the instigation of the United States Government. A French invention has effected the means of regulating the composition of such an alloy, and subsequent experiments in Glasgow revealed the fact that this alloy could be made in any good open hearth furnace working at a fairly high temperature as wel las in the crucible. In obtaining a correct idea of the value or usefulness of alloys of nickel with iron or steel it should be borne in mind that the composition is complicated by manganese, carbon, silicon, sulphur and phosphorus whose influence must be carefully watched, requiring a long series of experiments. A comparison of steel alloyed with 4·7 per cent nickel raised the elastic limit from 16 up to 28 tons, and the breaking strain from 30 up to 40 tons, without impairing the elongation or contraction of area to any noticeable extent. A further gradual increase of hardness was noticed until 20 per cent is reached, when a change takes place, and successive additions of nickel tend to make the steel softer and more ductile. The alloys polish well, and the colour of the steel is lightened as the proportion of nickel increases. They do not corrode as readily as other steel. The 1 per cent. nickel steels welds fairly well, but this property lessens with each addition of nickel. It can, therefore, be seen that considerable advantage may be expected from these alloys, especially where the percentage of nickel is less than five.

"The consumption of nickel and nickel alloy in the United States has increased from 294,000 pounds in 1880 to 421,000 pounds in 1888, while the total consumption of the world was estimated not to exceed 700 or 800 tons of the pure metal. The chief supply at present comes from New Caledonia, a penal colony of France (long. 165° E., S. lat. 22°). M. du Peloux states that the cost of production at this place could be so reduced that the company could sell at from 37 to 46 cents per pound, and yet have a good profit. Dr. Peters in his evidence before the Ontario Mining Commission states that the Canadian Copper Company could sell it from 25 to 30 cents per pound with a handsome profit. A commission appointed by the United States Government to examine the probable quantity of nickel in the Sudbury district has given a very glowing report to their government. It is highly probable, however, as can be seen from the above figures that our mines could supply the whole demand, even if the other sources of supply did not produce anything. It has been decided by the United States Government to make use of nickel steel armour plates, and already the contract has been awarded so that there is every prospect of a brilliant future for this mining industry around Sudbury. In view of our immense deposits it will be necessary to increase its consumption in every possible direction."

**Plant at Messrs. H. H. Vivian & Co's mine.**

The plant at the works of Messrs. Vivian & Co. differs somewhat from the rest. The cupola blast furnace is water-jacketed below, but the upper part is of brick and the matte and slag flow out into a fixed forehearth built also of brick, instead of into a movable " well " as at the two other mines. A further difference lies in the fact that in order to minimise the loss of nickel in the slag the production of a much lower grade matte is aimed at, whose percentage is subsequently raised by a sort of Bessemerizing process. For this purpose the matte is run into barrel shaped Manhé converters mounted on wheels. These are run on tracks from the furnance, under a hood connected with a stack. Air is blown through the molten matte by means of tuyeres penetrating the lower part of the converter and a further proportion of the sulphur and iron is removed by oxidation, the latter by combining with the silicious material present forming slag. The converters are lined with fire-clay and fine quartz mixed. After the matte is sufficiently Bessemerized most of the slag is run off and the last of it is chipped off the surface of the concentrated matte produced.*

**Exploration and discovery.**

Besides those of the Sudbury district, reports of discoveries from numerous other points have been rife. Many of these reports have been ill-founded or unimportant, but two deserve special notice.

One of these is situated about two miles east of Schrieber Station on the Canadian Pacific Railway, where Messrs. Marks, of Port Arthur, have located what is said to be a large deposit similar to those at Sudbury.

**New Brunswick.**

The other is situated about three miles from the town of St. Stephen, in Charlotte county, New Brunswick. It is said to contain 3 to 4 per cent of nickel. A correspondent in that district writes us that it is a very large deposit and describes the enclosing rocks as highly altered sandstones, argillites and fine conglomerates, cut in all directions by dykes of trap, in which felspar and black mica are the prominent minerals. This locality is underlain by rock marked as of Cambro-Silurian age on the published maps of the survey, but which, it is believed, may contain areas of older rocks.

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*Mr. A. Merry. jr., who was for many years on the technical staff of Messrs. H. H. Vivian's Smelting Works at Swansea, England, and who was manager for the firm at Sudbury during the erection of the plant and inauguration of the works, makes the following comments, comparing the cupolas in use by the different companies:—

"There are two such cupolas, the one has a fixed 'forehearth' or 'well,' and the other is on wheels, though there is not much advantage in the latter as the former seldom requires more than slight repairs necessitating no greater delay than the time spent in blowing down to change the movable well on wheels. We have worked both systems for many years and this is the opinion on their comparison. The wells are built to suit the requirements of the converter which is not the case with the wells of the other companies who hitherto only melted to cupola matte."

New Brunswick.

Mr. W. F. Best, of St. John, N.B., who is local Dominion Analyst, furnishes the following data. He says :—

"Samples were taken at about 17 feet from surface, and a New York chemist finds—

| | |
|---|---|
| Sulphur | 32·93 |
| Iron | 56·00 |
| Copper | 1·03 |
| Nickel | 2·04 |
| Gold | Trace. |
| Silver | " |
| Insoluble residue | 8·00 |
| | 100·00 |

"I have found as high as 2·48 per cent of nickel at nineteen feet from surface in pit No. 2." *

British Columbia.

The report of the Minister of Mines of British Columbia alludes to the existence of a deposit of nickel ore on the west bank of the Kootenay River in the Toad Mountain district. It is said a crosscut eight feet long failed to reach the wall of the deposit, thus proving it to have at least that thickness.

Outside of the Sudbury district the developments made on the deposits of ores of this metal have been slight, simply consisting of preliminary testing of the same.

Nickel City.

At Nickel City, near Whitefish Station on the Algoma branch, works are being erected, which it is hoped will be operating next year, where it is proposed to grind and then treat the ore by a special method, of which particulars could not be obtained, but which is said to be some sort of wet process, gold and silver ores being also dealt with.

Production.

There were shipped from this district, by rail, the following quantities of nickeliferous material :—

| | |
|---|---|
| Matte | 3,693 tons. |
| Ore | 1,351 " |

The amount of fine nickel in the matte, etc., produced and shipped during the year, by direct returns, came to 1,435,742 pounds, which, taken at the average market value of 65 cents per pound, is worth $933,232. As the above basis of valuation has been commented upon, it may be well to explain that it has been thought best to adopt it owing

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* A sample subsequently collected from the deposit weighing about 75 pounds and consisting almost altogether of pyrrhotite, chalcopyrite being practically absent, has since been subjected to analysis in the Laboratory of the Geological Survey and found to contain nickel, 1·718, cobalt, 0·165 per cent, with 5·43 per cent of gangue matter. For further details regarding which see forthcoming Chemical Contributions to the Geology of Canada, Vol. V, Report of Geological Survey Department.

to its being in keeping with the practice commonly followed for the metals. It also recommends itself as the only method of attaining a common basis of valuation, when, as in the case of the metals, the material is shipped in such various stages of concentration or preparation. Of course, owing to the expense of the subsequent stages of extraction, the price obtainable for the metal in the matte would be much below the market price as given above for fine nickel, only counting about 13 cents per pound for the nickel and 6 cents per pound for the copper. Where no allowance is made by the buyers, the price given for the nickel would range from 22 to 24 cents per pound. Assuming then an average price of 23 cents, this would make the total value of all the matte shipped $330,220, or at 13 cents per pound, $186,646.

Imports into U.S.A. and prices.

We are indebted to the kindness of the Engineering and Mining Journal of New York for the following figures relating to prices, imports, etc., by the United States, the result of enquiries made by them. They point out with regard to price that as the nickel trade is conducted, the bulk of transactions are made for long periods and the spot business is small, so that it is impossible to show the actual condition of the markets at short intervals. However, during 1890 it ranged between 60 and 80 cents per pound. At the beginning of the year it was 60 cents and some large contracts were made at even slightly lower figures. The price reached 80 cents about the middle of the year and remained at that point until the financial troubles in November, after which it fell to 60 cents.

NICKEL.

TABLE 1.

IMPORTS BY THE UNITED STATES.

Imports of Nickel by the United States—Calendar Year 1890.

| | Lbs. | |
|---|---|---|
| In ore and matte | 78,685 | $ 20,683 |
| Nickel, nickel in alloys, and nickel oxide | 611,898 | 300,231 |
| | 690,583 | 320,914 |

## NICKEL.

### TABLE 2.

### IMPORTS BY THE UNITED STATES.

Imports of Nickel by the United States—Fiscal Year ending 30th June, 1890.

| | Lbs. | |
|---|---|---|
| In ore, matte and other crude forms, all from Canada | 111,201 | $ 11,687 |
| Nickel, nickel in alloys and nickel oxide, from England | 208,309 | 105,572 |
| do do France | 85,410 | 33,485 |
| do do Germany | 127,771 | 52,256 |
| | 532,691 | 203,000 |

**Uses.**

**Probable supply.**

Besides the already mentioned uses a large demand should eventually arise for nickel steel, apart from its application to armour plate, in the general construction of ships and in many other directions, so that a market should grow up for this metal at fairly remunerative prices. It is hardly likely, however, that the price will keep very high, as apart from all the foreign deposits at present known to exist, there is every likelihood of the discovery of other important districts in Canada itself. The known areas of similar Huronian rocks are quite numerous and extensive, especially in the great Archæan region extending all the way from the coast of Labrador, along the northern side of the St. Lawrence and Ottawa River valleys and the north shores of Lakes Huron and Superior, to the edge of the younger rocks underlying the prairie sections of the west at Lake Manitoba, whilst the belt of Huronian rocks of the Sudbury district itself is known to extend a long way to the north-east. Whilst many of these areas are too far away to be sufficiently accessible for a long time, yet there are many which are well within reach of, or actually traversed by, the Canadian Pacific Railway. Whether the geological conditions favourable to the existence of nickeliferous pyrrhotite bodies, other than the existence of Huronian rocks, are there to be found, remains yet to be proved.

We cannot say either that nickel-bearing ores are confined to this formation, so that many of the large bodies of pyrrhotite already known to exist in various places may on examination be found to carry the metal in workable quantities.

Considerable interest has been taken in this industry during the past year, owing to the prominence given to it in the newspapers, following on the successful trials of nickel steel for armour plate. This led to renewed activity in prospecting, the subject being brought into further prominence by the visits of the allied societies of the British Iron and Steel Institute and the American Institute of Mining Engineers, on two successive occasions, to the Sudbury mines, which has led to a certain amount of acquisition of properties by outside capital.

The temporary withdrawal of the mineral lands from sale by the Ontario Government, and the proposed imposition of a royalty, has, however, toward the end of the year, caused somewhat of a lull in the activities of the Sudbury district.

## PETROLEUM.

Ontario.

The only oil-producing territories in Canada during 1890 were as in previous years the Petrolia and Oil Springs fields, in the township of Enniskillen, Lambton county.

No new developments are reported from this township, nor has the field been extended, though drilling operations are constantly being carried on, new wells being "brought in" to replace those abandoned. For a description of this field see report of the Division of Mineral Statistics and Mines for 1889, part S, Vol. IV, 1888-89.

In no other part of Ontario were drilling operations undertaken in search of oil, though it is said that in boring for gas at Comber, in Essex county, oil was obtained, though not in sufficient quantity to be of commercial value.

Quebec.

In Quebec operations were being carried on in the vicinity of Gaspé Basin though with what success was not ascertained.

It is proposed to further investigate this district during the present year.

Oil has several times been reported as occurring in commercial quantities near Pointe aux Trembles. That there is no truth in the reports may be readily understood by the following words of Mr. A. P. Low, who during his investigations in that district, visited and thus reports upon the locality:—

"The indications of petroleum at Pointe aux Trembles were investigated; the Utica shales were there found to be highly impregnated with oil, but as the shale and limestone appear to form a synclinal basin in the Archæan valley, with only a few low, narrow anticlinal ridges, the possibility of a large collecting area for oil under the shales is doubtful."

British Columbia.

An important discovery was made during the year in the South Kootenay Pass in Alberta and British Columbia, where oil was found occurring in natural springs, but in what quantity is not yet known. It is of a pale greenish yellow and appears to be of very light gravity, similar to the celebrated Washington county crude oil of Pennsylvania. Very little is as yet known of this occurrence, though in all probability investigations will shortly be made.

North-West Territories.

Regarding the occurrence of tar sands and maltha deposits in the Athabasca region, Mr. R. G. McConnell, who carried on investigations in that district, in his summary report to the Director of the Survey, says:—

Athabasca, Tar-sands.

"The valley of the Athabasca for a hundred miles above Lake Athabasca shows only alluvial sands, and the boulder-clays associated with stratified sands and gravels. Beds of rolled tar-sand pebbles occur in the latter in a number of places. A coarse gravel bed which immediately underlies the surface, and overlies the boulder-clay was found to be completely saturated with soft tar. Ten miles below Calumet River the Devonian limestone rises to the surface of the valley from beneath the glacial beds and almost immediately afterwards is overlaid by the tar-bearing sands of the Cretaceous. From this point the Devonian limestones undulating at low angles, and accompanied by the tar-sands, are exposed at frequent intervals as far as Crooked Rapid, a distance of about eighty miles. At Crooked Rapid they become affected by a slight south-westerly dip and sink below the surface of the valley, and eight miles farther on, at Boiler Rapid, the tar-sands also disappear, and are replaced by higher divisions of the Cretaceous.

"The tar-sands mentioned above belong to the Dakota formation and constitute in this region the basal member of the Cretaceous system. They rest unconformably on the Devonian limestones. Lithologically they may be described as soft sandstone, the cementing material of which is a bitumen or inspissated petroleum derived from the underlying limestones. The sands are siliceous and usually rather fine-grained, but also grade occasionally into a coherent grit. The eastern boundry of the tar-sands was not precisely defined, but their outcrop was estimated to have a minimum distribution of fully 1,000 square miles. In thickness they vary from 150 to 225 feet. The tar is unequally distributed through the sands, in some places merely staining the grains, but in most of the sections examined it is present in sufficient quantity to render the whole mass more or less plastic. An analysis by Mr. Hoffmann of a specimen collected some years ago by Dr. Bell gave by weight:—

| | |
|---|---|
| Bitumen | 12·42 |
| Water (mechanically mixed) | 5·85 |
| Siliceous sands | 81·73 |

A cubic foot of the bituminous sand rock weighs, according to Mr. Hoffmann, 117·5 lbs. This figure multiplied by the percentage of bitumen, 12·42, gives 14·59 lbs. as the amount of bitumen present in a cubic foot, Athabasca tar-sands.

or $\frac{14\cdot59}{63\cdot7} = 22\cdot9$ per cent in bulk. At the minimum thickness of 150 feet, and assuming the distribution as given above at 1,000 square miles, the bituminous sand rock in sight amounts to 28·40 cubic miles. Of this mass, if the preceding analysis is taken as an average, although this is probably rather high, 22·9 per cent in bulk or 6·50 cubic miles is bitumen. This calculation can, of course, only be ragarded as an approximation, but will serve to give some idea of the enormous outpouring of bituminous substances which has taken place in this region. The amount of petroleum which must have issued from the underlying limestones required to produce 6·50 cubic miles of bitumen cannot be estimated, as the conditions of oxidation and the original composition of the oil are unknown. It must, however, have been much greater than the amount of bitumen.

"A few miles west of the Athabasca the sand rock, still saturated with tar, passes below the higher divisions of the Cretaceous, and its extension in this direction can only be ascertained by boring. It was not recognized on Peace River nor on the lower part of Red River, and must disappear somewhere in the intervening region.

"In ascending the Athabasca the tar-sands, after an exposure of over twenty miles, pass below the surface at Boiler Rapid and are not seen again. Above this the upper divisions of the Cretaceous, influenced by a light south-westerly dip, and also by the grade of the stream descend gradually in the banks of the valley and disappear in succession. The Cretaceous section is as follows in descending order:—

| | | Feet. |
|---|---|---|
| Cretaceous. | Pierre shales | 700 |
| | Niobrara sand and sandstone | 35 |
| | Niobrara shales | 90 |
| | Niobrara sand and sandstone | 300 |
| | Benton shales | 275 |
| | Dakota tar-sands | 175 |
| | | 1,575 |
| | Devonian limestone | |

"The commercial value of the tar-sands themselves, as exposed at the surface, is at present uncertain. But the abundance of the material and the high percentage of bitumen which it contains makes it probable that it might, in the future, be profitably utilized for various purposes. It proves a flow of petroleum to the surface unequalled elsewhere in the world, but its more volatile constituents have long since disappeared, and the rocks from which it issued are probably exhausted. In their extension under cover, however, the case is different, and it is here that oils of economic value must be sought. Above Boiler Rapid the tar-sands

Athabasca tar-sands.

are overlaid by a cover of shales, sufficient to prevent the oil from rising to the surface, and as we ascend the river this cover gradually thickens. The geological attitude of the cover is not the most favourable, as the beds dip away from the outcrop at the rate of about six feet to the mile, and it is possible that part or even the whole of the oil may have flowed northwards and eastwards through the Dakota sands and escaped where these come to the surface. It is unlikely, however, that all the oil has escaped in this manner, as small anticlinals in the covering beds are almost certain to exist, and a differential hardening of the sands themselves may serve to enclose reservoirs or pools of large capacity. It is also possible that the sands at their outcrop, may, by the deposition of tarry substances, be plugged tightly enough to prevent further egress.

"Favourable indications of the presence of oil are afforded by the existence of several natural gas springs in the valley of the Athabasca above Boiler Rapid. One of these occurs at the mouth of Little Buffalo River and is twenty miles distant in a straight line from the outcrop of the tar-sands. The gas here forces its way from the sands up through a covering of 250 feet of Benton shales and issues from the surface in numerous small jets distributed over an area fifty feet or more in diameter. Some of the jets when lighted burn steadily until extinguished by heavy rains or strong wind, and afford sufficient heat to cook a camp meal. A second spring was noticed thirteen miles below the mouth of Pelican River, or forty miles in a straight line from the outcrop of the tar-sands at Boiler Rapid. The volume of gas escaping here is less than at the mouth of Little Buffalo River, and in order to reach the surface it is obliged to penetrate 570 feet of shales and sand. Escaping jets of gas were also noticed at several points further up the river, but these were mostly small and may possibly be due to decaying vegetable matter.

"The question of the continuity of the tar-sands, and their petroliferous character under cover, can only be settled in a decided manner by boring, and it is highly desirable that drilling operations should be undertaken for this purpose. The indications seem amply sufficient to warrant the small expenditure involved, and the advantages which would accrue from a successful issue of the search to this portion of the North-West are almost incalculable. The southern limit of the field cannot, without present knowledge or without boring, be defined; it may possibly extend to the Saskatchewan or beyond, as even as far as Manitoba the rocks are more or less petroliferous.

"Two bore holes, one at the mouth of Lac la Biche River, and the other at the mouth of the Pelican, would add largely to our knowledge of the underground geology of this region, and would either settle positively the question as to the presence or absence of petroleum in paying quantities, or at least afford valuable data for future action. At the mouth of the Pelican River, a bore hole, in order to reach the tar-sands, would require to be sunk 700 feet, and at the mouth of Lac la Biche River about 1,200 feet. The former locality is 50 miles distant in a straight line from the outcrop of tar-sand at Boiler Rapid. The latter is 106 miles distant from the same point, and is only 110 miles from Edmonton."

Producers.

*Statistics.*—During 1890 there were twelve refineries in operation, eight of which are located in Petrolia, two in London, one in Sarnia and one in Hamilton, as follows:—

| | |
|---|---|
| Imperial Oil Co | Petrolia. |
| M. J. Woodward & Co | do |
| John McDonald | do |
| Petrolia Oil Co. | do |
| Consumers' Oil Co | do |
| McMillan, Kittridge & Co | do |
| Premier Oil Co | do |
| Jno. McMillan | do |
| Jno. R. Minhinnick | London. |
| W. Spencer & Co | do |
| Sarnia Oil Co | Sarnia. |
| Canadian Oil Co | Hamilton. |

These refineries employ about 250 men in and about the works, and throughout the oil-producing territory there are about 2,000 men employed either directly or indirectly in the production of crude and refined oil. The wages paid for skilled labour in the production of refined oil are from $2.00 to $2.50 per day, while ordinary labour, in and around the refineries, is paid for at the rate of from $7.00 to $10.00 per week.

Apart from those engaged in the refining of oil there is quite a staff of drillers busily engaged throughout the year in sinking wells, of which about 400 are annually drilled, to replace a nearly similar number that are annually abandoned.

Production.

From returns made direct to this office there were 28,412,341 gallons, or 811,781 barrels, of crude oil received at the refineries, of which 28,267,746 gallons were consumed in the manufacture of the various products of petroleum, deducting from this a decrease in stocks of the tanking companies, amounting to 117,089 barrels, there is found to have been an approximate production of crude oil of 695,000 barrels, an increase, when compared with the figures of the year previous, obtained in the same manner, of 54,701 barrels.

These figures are, of a necessity, only approximate, as the change in stocks at the refineries, if any, was not obtained. At the average price of oil for the year, $1.18, the value of the above quantity of oil would be $820,100.

As in previous years, however, the production and value of oil as shown in the summary table of production is obtained by computation from the inspection returns of the Inland Revenue Department.

Tanking companies.

The tanking companies operating as such were:—

The Petrolia Crude Oil and Tanking Co., Petrolia; The Crown Warehousing Co., Petrolia; The Producers Tanking Co., Petrolia, all of whom have kindly furnished us with returns of the year's operations, of which the following is a résumé:—

| | |
|---|---|
| Stocks, 1st January, 1890 | 213,772$\frac{32}{35}$ |
| Quantity of oil received | 480,963$\frac{8}{35}$ |
| do delivered | 598,052$\frac{7}{35}$ |
| Stocks, 1st January, 1891 | 96,683$\frac{33}{35}$ |
| Decrease of stocks during year | 117,088$\frac{34}{35}$ |

The returns of the several refineries above referred to give the following results:—

PETROLEUM.

TABLE 1.

PRODUCTION OF CANADIAN OIL REFINERIES.

| Products. | | 1889. | | 1890. | |
|---|---|---|---|---|---|
| | | Quantity. | Value. | Quantity. | Value. |
| Illuminating oils | galls. | 9,479,917 | $1,084,829 | 11,129,277 | $1,264,677 |
| Benzine and naphtha | " | 409,135 | 34,861 | 636,247 | 37,026 |
| Paraffine oils | " | 703,025 | 87,936 | 446,888 | 64,713 |
| Gas oil | " | 2,917,346 | 65,954 | 4,246,447 | 84,752 |
| Lubricating oils and tar | " | 2,191,881 | 96,407 | 2,877,388 | 130,349 |
| Paraffine wax | lbs. | 561,820 | 44,197 | 913,730 | 56,903 |
| Totals | | | $1,414,184 | | $1,638,420 |

## PETROLEUM.

### TABLE 2.

### CONSUMPTION OF CRUDE OIL AND CHEMICALS.

| Articles. | | 1889. | 1890. |
|---|---|---|---|
| Crude petroleum.......... | galls. | 25,066,275 | 28,267,746 |
| Sulphuric acid........... | lbs. | 3,638,704 | 4,284,826 |
| Soda...................... | " | 380,487 | 336,758 |
| Litharge.................. | " | 477,969 | 443,922 |
| Sulphur.................... | " | 76,325 | 85,729 |

Inspection returns.

e following figures and tables, 3 and 4, are taken from the books of nland Revenue Department, and show the number of packages of lian oil inspected during the calendar year 1890, as well as the quantity of refined oil, imported and domestic, inspected during the years from 1881 to 1890, inclusive.

ring 1890 the packages of Canadian oil inspected were:—

236,997 ........................ @ 10 cents inspection fee
9.............................. @ 5 do do
44,186......................... @ 2½ do do

suming that these packages contain 42, 10 and 5 gallons reively, there is found to be an approximate inspection of

9,953,874 gallons in packages of 42 gallons each.
90 do do 10 do
220,930 do do 5 do

otal inspection of 10,174,894 gallons.

is amount computed at an average percentage of the crude oil of ould be equivalent to a consumption of crude of 26,776,037 gallons, 5,029$\frac{22}{35}$ barrels, which at the average price of crude oil during the $1.18 per barrel, would be valued at $902,734.

## PETROLEUM.

### TABLE 3.

### CANADIAN OILS AND NAPHTHA INSPECTED AND CORRESPONDING QUANTITIES OF CRUDE OIL.

| Fiscal Year. | Refined Oils Inspected. | Crude Equivalent Calculated. | Ratio of Crude to Refined. |
|---|---|---|---|
| | Galls. | Galls. | |
| 1881 | 6,406,783 | 12,813,566 | 100 : 50 |
| 1882 | 5,910,787 | 13,134,993 | 100 : 45 |
| 1883 | 6,970,550 | 15,490,111 | 100 : 45 |
| 1884 | 7,656,011 | 19,140,027 | 100 : 40 |
| 1885 | 7,661,617 | 19,154,042 | 100 : 40 |
| 1886 | 8,149,472 | 21,445,979 | 100 : 38 |
| 1887 | 8,243,962 | 21,694,637 | 100 : 38 |
| 1888 | 9,545,895 | 25,120,776 | 100 : 38 |
| 1889 | 9,462,834 | 24,902,195 | 100 : 38 |
| 1890 | 10,121,210 | 26,634,763 | 100 : 38 |

In the following table (4) is given the total amount of illuminating oil, both domestic and imported, inspected during the fiscal years from 1881 to 1890, and represents the market for that product in Canada :—

## PETROLEUM.

### TABLE 4.

### TOTAL AMOUNT OF OIL, IMPORTED AND CANADIAN, INSPECTED.

| Fiscal Year. | Imported. | Canadian. | Total. |
|---|---|---|---|
| | Galls. | Galls. | Galls. |
| 1881 | 476,784 | 6,406,783 | 6,883,567 |
| 1882 | 1,351,412 | 5,910,747 | 7,262,159 |
| 1883 | 1,190,828 | 6,970,550 | 8,161,378 |
| 1884 | 1,142,575 | 7,656,011 | 8,798,586 |
| 1885 | 1,278,115 | 7,661,617 | 8,939,732 |
| 1886 | 1,327,616 | 8,149,472 | 9,477,088 |
| 1887 | 1,665,604 | 8,243,962 | 9,909,566 |
| 1888 | 1,821,342 | 9,545,895 | 11,367,237 |
| 1889 | 1,767,812 | 9,462,834 | 11,230,646 |
| 1890 | 2,020,742 | 10,121,210 | 12,141,952 |

Prices. The following information regarding prices of crude oil has very kindly been furnished by Mr. James Kerr, and indicates the prices crude oil as quoted on the Petrolia Oil Exchange :—

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| 1884 | 7,656,011 | 19,140,027 | 100 : 40 |
| 1885 | 7,661,617 | 19,154,042 | 100 : 40 |
| 1886 | 8,149,472 | 21,445,979 | 100 : 38 |
| 1887 | 8,243,962 | 21,694,637 | 100 : 38 |
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### PETROLEUM.

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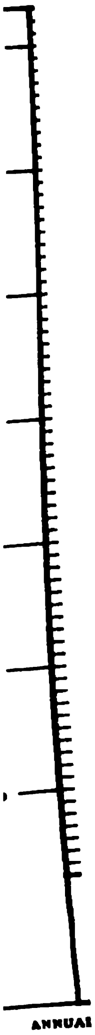

ANNUAL

Pı

### PETROLEUM.

### TABLE 5.

PETROLIA OIL EXCHANGE, CRUDE PETROLEUM BUSINESS FOR THE YEAR 1890.

| 1890. | Opening Price. | Highest Price. | Lowest Price. | Closing Price. | Average Closing Price. | Sales. (Barrels.) |
|---|---|---|---|---|---|---|
| uary | $1 01½ | $1 03 | $1 01¼ | $1 02¼ | $1 02 | 41,417 |
| uary | 1 02¼ | 1 11 | 1 02 | 1 08½ | 1 06 | 43.872 |
| ch. | 1 08½ | 1 09½ | 1 05½ | 1 05½ | 1 07¼ | 31,494 |
| l | 1 07¾ | 1 10 | 1 06¼ | 1 08½ | 1 08 | 19,551 |
|  | 1 08 | 1 08 | 1 07 | 1 07½ | 1 07½ | 28,284 |
|  | 1 07¾ | 1 16 | 1 07¾ | 1 16 | 1 10¼ | 40,063 |
|  | 1 16 | 1 37 | 1 16 | 1 37 | 1 23 | 33,679 |
| ust | 1 35½ | 1 35½ | 1 31 | 1 32 | 1 32¾ | 27,271 |
| ember | 1 31¾ | 1 31¾ | 1 27¾ | 1 30¾ | 1 30½ | 32,047 |
| ber | 1 31 | 1 32 | 1 28 | 1 28 | 1 29 | 36,822 |
| ember | 1 28½ | 1 36¼ | 1 28½ | 1 35 | 1 32¾ | 27,600 |
| mber | 1 35 | 1 35 | 1 27 | 1 30 | 1 30 | 32,824 |
| 1890 | 1 01½ | 1 37 | 1 01¼ | 1 30 | 1 18 | 394,924 |
| 1889 | 1 21 | 1 21 | 80 | 1 01 | 92¾ | 400,932 |
| 1888 | 75½ | 1 23½ | 71 | 1 23 | 1 02¾ | 516,007 |

e following tables of exports and imports of oil are compiled from mation obtained from the Customs Department and explain thems :—

Exports and imports.

### PETROLEUM.

### TABLE 6.

EXPORTS OF CANADIAN CRUDE AND REFINED PETROLEUM FROM 1873 TO 1890.

| Calendar Year. | Gallons. | Value. |
|---|---|---|
| 1873 | 5,869,579 | $1,287,576 |
| 1874 | 28,946 | 2,509 |
| 1875 | 11,836 | 2,214 |
| 1876 | 2,533,772 | 583,550 |
| 1877 | 1,431,883 | 323,013 |
| 1878 | 609,171 | 85,571 |
| 1879 | 235,171 | 17,032 |
| 1880 | 3,085 | 751 |
| 1881 | 501 | 99 |
| 1882 | 1,119 | 286 |
| 1883 | 13,283 | 710 |
| 1884 | 1,098,090 | 30,168 |
| 1885 | 337,967 | 10,562 |
| 1886 | 241,716 | 9,855 |
| 1887 | 473,559 | 13,831 |
| 1888 | 196,602 | 74,542 |
| 1889 | 235,855 | 10,777 |
| 1890 | 420,492 | 18,154 |

### PETROLEUM.

### TABLE 7.

### IMPORTS OF CRUDE AND REFINED PETROLEUM.

| Fiscal Year. | Gallons. | Value. |
|---|---|---|
| 1880 | 687,641 | $131,359 |
| 1881 | 1,437,475 | 262,168 |
| 1882 | 3,007,702 | 398,031 |
| 1883 | 3,086,316 | 358,546 |
| 1884 | 3,160,282 | 380,082 |
| 1885 | 3,767,441 | 415,195 |
| 1866 | 3,819,146 | 421,836 |
| 1887 | 4,290,003 | 467,003 |
| 1888 | 4,523,056 | 408,025 |
| 1889 | 4,650,274 | 484,462 |
| 1890 | 5,075,650 | 515,852 |

Subtracting the quantities of imported oils inspected (table 4) from those shown in table 7, there is found to have been an annual importation of oil, crude, and other than illuminating, as is shown in the following table 8:—

### PETROLEUM.

### TABLE 8.

### IMPORTS OF CRUDE AND MANUFACTURED OILS OTHER THAN ILLUMINATING.

| Fiscal Year. | Gallons. |
|---|---|
| 1881 | 960,691 |
| 1882 | 1,656,290 |
| 1883 | 1,895,488 |
| 1884 | 2,017,707 |
| 1885 | 2,489,326 |
| 1886 | 2,491,530 |
| 1887 | 2,624,399 |
| 1888 | 2,701,714 |
| 1889 | 2,882,462 |
| 1890 | 3,054,908 |

Paraffine wax.

The imports of paraffine wax and paraffine wax candles are given in the following tables 9 and 10:—

PETROLEUM.

TABLE 9.

IMPORTS OF PARAFFINE WAX.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1883. | 43,716 | $ 5,166 |
| 1884. | 39,010 | 6,079 |
| 1885. | 59,967 | 8,123 |
| 1886. | 62,035 | 7,953 |
| 1887. | 61,132 | 6,796 |
| 1888. | 53,862 | 4,930 |
| 1889. | 63,229 | 5,250 |
| 1890. | 239,229 | 15,844 |

Paraffine wax candles.

PETROLEUM.

TABLE 10.

IMPORTS OF PARAFFINE WAX CANDLES.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880. | 10,445 | $2,269 |
| 1881. | 7,494 | 1,683 |
| 1882. | 5,818 | 1,428 |
| 1883. | 7,149 | 1,734 |
| 1884. | 8,755 | 2,229 |
| 1885. | 9,247 | 2,449 |
| 1886. | 12,242 | 2,587 |
| 1887. | 21,364 | 3,611 |
| 1888. | 22,054 | 2,829 |
| 1889. | 8,038 | 1,337 |
| 1890. | 7,233 | 1,186 |

## PHOSPHATE.

Production

The production of this mineral for 1890, as shown by direct returns to this office, amounted to 31,753 tons, having a spot value of $361,045. These figures show an increase of 765 tons and $44,383 as compared with the figures of production for last year.

The yield of the two districts to the grand total is as follows:—

| | No. of tons. | No. of Producers. |
|---|---|---|
| Quebec district | 27,172 | 11 |
| Ontario do | 4,581 | 15 |

Exports.

The following tables, Nos. 1 and 2, explain themselves, graphic table A giving the total exports for the whole Dominion for this and past years :—

### PHOSPHATE.

### TABLE 1.

### EXPORTS OF PHOSPHATE.

| Year. | Ontario. | | Quebec. | |
|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. |
| 1878.... | 824 | $12,278 | 9,919 | $195,831 |
| 1879.... | 1,842 | 20,565 | 6,604 | 101,470 |
| 1880.... | 1,387 | 14,422 | 11.673 | 175,664 |
| 1881.... | 2,471 | 36,117 | 9,497 | 182,339 |
| 1882.... | 568 | 6,338 | 16,585 | 302,019 |
| 1883.... | 50 | 500 | 19,666 | 427,168 |
| 1884.... | 763 | 8,890 | 20,946 | 415,350 |
| 1885.... | 434 | 5,962 | 28,535 | 490,331 |
| 1886.... | 644 | 5,816 | 19,796 | 337,191 |
| 1887.... | 705 | 8,277 | 22,447 | 424,940 |
| 1888.... | 2,643 | 30,247 | 16,133 | 268,362 |
| 1889.... | 3,547 | 38,833 | 26,440 | 355,935 |
| 1890.... | 1,866 | 21,329 | 26,591 | 478,040 |

### PHOSPHATE.

### TABLE 2.

G. B. imports

### GREAT BRITAIN : IMPORTS OF CANADIAN APATITE COMPARED WITH TOTAL IMPORTS OF PHOSPHATES IN THAT COUNTRY.

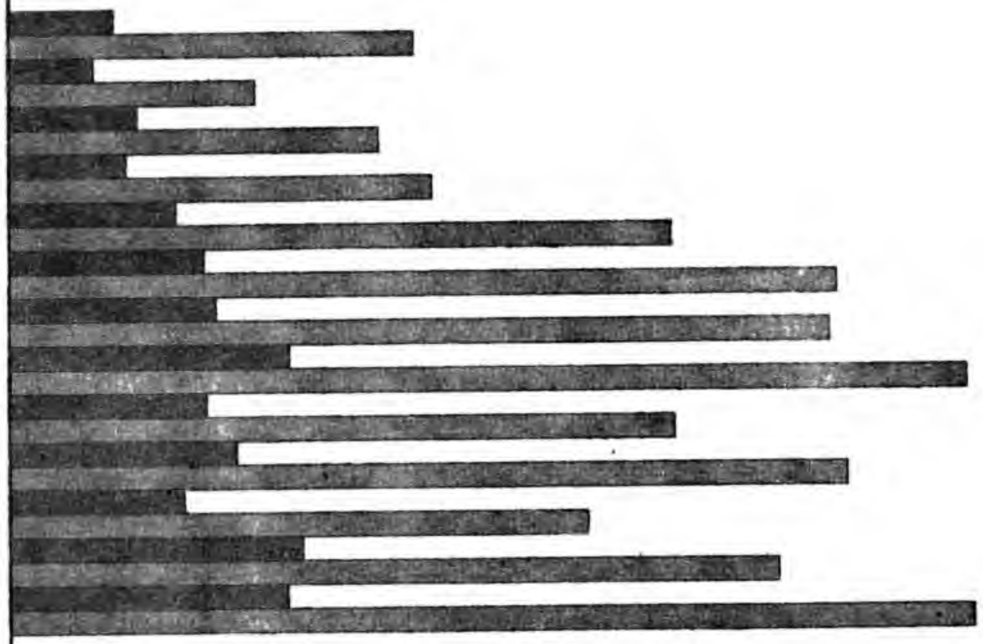
| Year. | Canadian Apatite. | | Total Phosphates. | | Per cent of Value of Canadian Apatite to total Value. |
|---|---|---|---|---|---|
| | Long Tons | £ stg. | Long Tons | £ stg. | |
| 1882.... | 8,187 | 39,851 | 199,428 | 613,198 | 6·5 per cent. |
| 1883.... | 16,531 | 66,714 | 246,945 | 813,825 | 8·2 do |
| 1884.... | 15,716 | 52,370 | 219,225 | 643,851 | 8·1 do |
| 1885.... | 21,484 | 76,179 | 238,572 | 628,027 | 12·1 do |
| 1886.... | 18,069 | 63,490 | 223,111 | 526,885 | 12·0 do |
| 1887.... | 19,194 | 65,974 | 283,415 | 614,088 | 10·7 do |
| 1888.... | 12,423 | 42,291 | 257,886 | 544,919 | 7·7 do |
| 1889.... | 23,123 | 71,037 | 304,953 | 703,704 | 10·1 do |
| 1890.... | 21,089 | 65,420 | 343,501 | 849,452 | 7·8 do |

# PHOSPHATE

## TABLE A

ANNUAL EXPORTS

| Year | Quantity | Value |
|---|---|---|
| | Tons | $ |
| 1878 | 10,743 | 208,109 |
| 1879 | 8,446 | 122,035 |
| 1880 | 13,060 | 190,086 |
| 1881 | 11,968 | 218,456 |
| 1882 | 17,153 | 338,357 |
| 1883 | 19,716 | 427,668 |
| 1884 | 21,709 | 424.240 |
| 1885 | 28,969 | 496,293 |
| 1886 | 20,440 | 343,007 |
| 1887 | 23,152 | 433,217 |
| 1888 | 18,776 | 298,609 |
| 1889 | 29,987 | 394,768 |
| 1890 | 28,457 | 499,309 |



Occurrence of deposits.

ıe industry continues to be prosecuted as formerly in the two dis- s of Ottawa county, Quebec, and in that of Eastern Ontario. In e two districts the phosphate deposits are found in rocks of Lauren- age.

Quebec.

ı the Ottawa county district these consist largely of gneisses, gran- gneisses with pyroxenite belts and considerable areas of crystalline ıstone. The pyroxenite rocks are apparently intrusive in the ssic rocks and all the phosphate deposits of importance occur in n. The gneissic rocks form the greater proportion of the area in ch the working mines of this district are included and often merge rocks having a similar mineralogical composition, but a granitic cture, the parallel arrangement of the minerals being entirely absent. he belts of pyroxenite run parallel with the general strike of the sur- ıding rocks, but at their contact show evidences of their intrusive re and throughout them at places there are developments of a rock ısisting almost altogether of somewhat coarsely crystallized felspar ch frequently shows a peculiar violet or blue colour on the cleavage s.

he phosphate bodies are distributed through these belts in the most gular manner. Each one varying from the other in the details of characteristics, showing in common, however, the feature of extreme gularity. In a few instances they show a general extension of the ıphate in a plane which gives the openings made on them the appear- ı of having followed a vein, but there are no walls nor sharp planes ivision which persist for any distance between the phosphate and osing rock. Most of the excavations made show the bodies of mineral ave been of extremely irregular shape; merging into the enclosing c and holding a very varying proportion of intermixed rock. At es very large bodies of almost pure phosphate have been encountered, ding many thousand tons.

he intermixed material consists, almost without exception, of pyrox- e, although some pits show considerable developments of pink ite and at places a good proportion of pyrite distributed through phosphate.

survey of the group of mines belonging to the Phosphate of Lime ıpany and the Canadian Phosphate Company, all of which are on one , shows a long string of pits and openings and strippings of very vary- dimensions, numbering probably 200 and covering a length of nearly miles, the width of the strip being about ten chains. This pyroxene has a general strike of N. 50° W. passing through the Crown Hill ᵋ, at its southern end and on to the High Rock and Star Hill mines. her north, about a mile, are the openings known as the Central Lake mine which also seems to be on an extension of this belt; it must therefore take a more northerly course, coming round to a strike of N. 25° W. Here, also, there are a number of openings extending on the belt for about three-quarters of a mile. Some work has also been prosecuted on the same belt south of the Crown Hill mine on the Ross Mountain, so that with these five mines we have a proved length of the belt of some four miles and a half with a possible continuation a mile further north to the High Falls mine of the General Phosphate Company, Limited.

The above constitute the largest connected group of mines of the district tributary to the River du Lièvre, on the west side of which they are situated, at a distance of about twenty miles above Buckingham village.

The other chief mines of this district are as follows:—

The North Star mine on the east side of the river near Tamo Lake and opposite the lower end of the High Rock belt, the output of which is carted a distance of about four miles to the river bank, to be shipped. The works at this place are concentrated within a length of about twenty chains on a narrow belt of pyroxenite about 120 feet wide striking N. 20° W. Here there are some fifteen or twenty openings of various dimensions, one shaft having attained a depth of about 600 feet. The surrounding rocks consist of distinctly banded gneisses with quartzite bands.

Passing down the river towards Buckingham we come to the group of mines in the vicinity of Little Rapids. Of these there were six working during the year. Five are on the east bank of the river, viz., the London and Little Rapids mines, near the Little Rapids locks, and the Emerald, Squaw Hill and Ætna mines, two miles and a half further down. The fourth, known as the Spruce Lake mine, is about opposite the Emerald on the other side of the river, about four miles in from the same. The strike of the pyroxene belts here was not so fully worked out as those further up the river, but they range about N.E. and S.W. or roughly at right angles with the others. The London and Little Rapids mines seem to be on two parallel and adjacent belts, or what may on further study turn out to be one belt divided at this point by a "horse" of barren rock. The Emerald and Squaw Hill workings are close together, comprised within a radius of about five chains whilst the Ætna mine is about half a mile further inland, and would seem to be on the extension of the same belt.

The mode of occurrence of the phosphate at these places shows no features very strikingly different from those above enumerated, except at the Emerald Mine where for the amount of mineral yielded during

e working of the mine it has been concentrated in a very small com-
ss, the hill in which it occurs being fairly honey-combed with exten-
e excavations.

All these mines bring their product to the River du Lièvre where
is loaded on large scows and towed down the river to Buckingham
llage. Here it is transhipped into railroad cars and taken thence over
e Canadian Pacific Railway to Montreal.

The Templeton sub-district is adjacent to that of the River du Lièvre,
it being the other side of the watershed of that river all its product is
ken out to the Canadian Pacific Railway at East Templeton station.

Here there is a large area of pyroxenite, throughout which deposits
apatite seem to be plentifully distributed. The most extensively
orked mine is that known formerly as the McLaurin and Blackburn
operty, now owned and operated by the Templeton District Phosphate
ining Syndicate, Limited, who are also opening up deposits at several
her points in the vicinity. Here is the famous "Big Pit" out of which
ich large quantities of the mineral have been taken since the commence-
ent of operations several years ago. Around it, within a radius of a mile,
number of other properties have been worked at various times during
ast years.

Chief amongst those in operation during 1890 are the following, viz.:—
. ½ lot 9, range XII. worked by Mr. Lewis McLaren, of Templeton; the
. ½ of lot 9, range X, worked by Mr. Falardeau; lot 9 in range IX,
orked by Messrs. Coursolles & Belcourt, of Ottawa, and lot 14, in range
., or the Pearson property, worked under the direction of Mr. Charles
ionais. The operations at most of these are of a preliminary nature,
esigned to open up and develop the properties.

In this locality the mode of occurrence of the phosphate is very simi-
ar to that of the district first described, although at the last named,
earson property, the mineral occurs in a number of well-defined veins
utting the containing pyroxene rock. On a visit to the property there
ere seen several veins running north-east and south-west, which seemed
ersistent and regular, and were crossed by others striking W. N. W.
hese veins, as far as exposed, showed a filling of calcite, in which
e apatite occurred being in the form of crystals where vugs had been
ncovered.

In the Gatineau River district, to the west of the last named, a number
properties have been proved to carry phosphate deposits on which
ring former years a fair amount of work was done, but of late there is
ry little to report from there in the way of development.

The working mines in the Ontario district are situated mainly in that Ontario.
rt of the county of Frontenac south of the Canadian Pacific line from

Montreal to Toronto and tributary to the Kingston and Pembroke Railway, comprising the townships of Oso, Hinchinbrooke, Bedford, Loughboro' and Storrington. Some few places were also worked in the townships of North Burgess and South Sherbrooke, Lanark county and in North Crosby township, Leeds county. This district will be all comprised within the triangular area bounded on the south and east by the Rideau canal, on the north by the Canadian Pacific Railway and on the west by the Kingston and Pembroke Railway.

The geological conditions are in general similar to those already described for the Ottawa county district, similar Laurentian rocks being found to occur. The phosphate deposits, however, take more the shape of regular veins and much of it is extracted from the crystalline limestones.

Some activity in the matter of developing phosphate deposits is reported from near Carp village, in Carleton county, and from Sebastopol township, in Renfrew county.

Characteristics of Canadian apatite.

Canadian apatite is generally of a green colour of varying shades, although more rarely red. Its texture varies much, even in the same pocket or deposit from the crystalline or "rock phosphate" to the finely granular aggregates aptly called "sugar phosphate." The former has the advantage that in process of extraction it can be obtained clean, forming the best grade of "lump phosphate." The latter kind in blasting out gets broken up finely and is apt, on account of the intimate intermixture of foreign material, to be classed and shipped as "seconds."

The mineral both of the Ontario and Quebec districts belongs to the variety fluor apatite. A series of eight analyses made by the chemical branch of the Survey in 1878* gave the following proportions:—tribasic phosphate of lime, 88·138 per cent. to 89.810 per cent. One exceptional specimen, however, ranging as low as 74·295 per cent—fluorine from 3·311 per cent to 3·863 per cent with a little chlorine, carbonate of lime and other things. These specimens were selected so as to be as free as possible from mechanically intermixed impurities that they might represent the composition of the pure mineral itself.

Mining methods.

The mining methods adopted are quite simple, viz.: Opening up pits wherever phosphate is found outcropping on surface either of sufficient purity and extent to pay or where it is believed development may prove a sufficiently extensive body. If such does not prove to be the case, the working is of course abandoned, otherwise the pit is extended in every direction, following the body of mineral until exhausted or until the policy of the management points to the advisability of suspension of work in order to concentrate on some more profitable body.

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*See Report of Progress, Geological Survey of Canada, 1877 78.

Mining methods.

Thus a phosphate "mine" presents the appearance of a number of pits of all sizes and shapes, mostly abandoned either permanently or temporarily and full of water, dotted irregularly all over the area of the phosphate-bearing belt comprised within the property of the company, amongst which at a few points active operations will be seen to be progressing. Owing to these facts mining operations must always be very irregular in their nature, nor can the economies due to a far-seeing arrangement of the work on a defined plan be secured, because the centre of operations is ever changing, and it is impossible to predict from month to month where it will be.

The larger operators use machine drills almost altogether, some few having large permanent air compressor plants supplying power over the whole property, by means of a system of pipes supplementing this at outlying points with machine drills worked from small portable boilers. Hoisting is done almost altogether by means of derricks erected and moved about as required, small portable steam or horse power hoists being used.

The material to be handled is considerable in comparison with the ield of pure phosphate, for whilst work may be carried on for short eriods in almost solid mineral the average of a good pit will run nearer re of rock hoisted to one of phosphate and oftener near ten to one at e less profitable points. As the pits are generally working downwards e waste rock has all to be hoisted, forming the extensive "dumps" hich are so noticeable a feature dotted all over a worked area.

The phosphate is cobbed and hand picked to free it from intermixed eign matter and graded into "firsts" and "seconds." The "firsts" nsist of the clean phosphate that can be picked out by hand, the econds" of the more finely divided material in which a certain amount intermixed rock, etc., must be left, which it would not pay to pick t. The "firsts" will range from 75 to 85 per cent, and the "seconds" om 60 to 75 per cent of tribasic phosphate of lime. The cobbing is her done at the pit's mouth or in temporary sheds at convenient aces in the vicinity, or, as with some of the larger mines, where the orks are more concentrated and systematised, they have one or two ntral cobbing sheds, stove heated for winter work, to which the terial is brought by tramways. The interior of one of these will show large square table on to which the mineral is dumped from the car ming in above and around which may be seen about 40 or 50 small ys busily hammering and sorting. Screening is used to a certain extent in separating the more easily pulverized phosphate of the "seconds" from the associated rocky portion, which on account of their greater hardness or toughness form the larger particles.

Owing to the often intimate admixture of phosphate through the rock the waste from the cobbing sheds and the dumps at the pits still shows a considerable amount of the mineral, which, however, it would not pay to extract.

In the River du Lièvre district the larger mines have tramways of considerable length for bringing their product to the shipping point on the river bank, where they have complete wharfage arrangements for either the direct placing of the mineral in the scows or for its temporary storage. The subsequent methods of shipment have been already described.

The operators of the Templeton sub-district suffer from having to haul their product some eleven miles out to the railway, waggons being the only available means. This adds from $2 to $3 per ton to the cost of laying down at the shipping point.

In the Ontario district the material will be brought out to the Canadian Pacific and Kingston and Pembroke railways, or the Rideau canal by waggon and shipped, most of it going to Montreal to join that from the other districts.

Markets and uses.

Nearly all the phosphate shipped from Canada finds a market in continental Europe and Great Britain, where it is used by the manufacturers of superphosphate. Some little, however, is similarly used in Canada, at the works of Messrs. Brodie, at Smith's Falls, and Messrs. Nichols & Co., at Capelton, P.Q. The latter firm continues to manufacture chemical manures of various grades, using Canadian phosphate and acid from their own sulphuric acid works at that place. The home consumption would not, however, amount to more than 600 or 700 tons.

A small quantity which is exported to the United States consists mostly of the lower grade mineral which is ground at the mills at Buckingham station.

With regard to the general course of the industry outside of the change of ownership of some of the older mines, the main feature has been the formation of a large company in London, England, known as the General Phosphate Corporation, Limited, with the purpose of making extensive purchases of phosphate lands. Although disappointed in raising the whole of the capital asked for, several properties were acquired and operations commenced late in the fall at the Ross Mountain and High Falls mines in the River du Lièvre district, where, also, two other new companies operated during the year, viz., the Dominion

Mining Company, at the London mine, and the Anglo-Continental Guano Company, at the Squaw Hill and Ætna mines.

Outside the operations in the old districts there is little to report regarding discovery and development of phosphatic materials elsewhere, except to allude to an interesting occurrence mentioned in the Summary Report of the Director of the Geological Survey for 1890, which speaks as follows:—"A specimen of phosphatic shale collected by him (Mr. Tyrrell) from the Niobrara formation on Wilson River, on the Lake Dauphin Plain, in Manitoba, was given for analysis to Mr. Hoffmann, who reports that it contains 17·27 per cent of phosphoric acid, equivalent to 37·7 per cent of tribasic phosphate of lime. A very small outcropping of this shale which is largely composed of fragments of fish remains was seen in the bank of the river, but if the bed proves to be an extensive one it will furnish a very valuable source of supply of phosphate of lime for the benefit of Manitoba and the country further west, being very similar in character to the coprolite beds of England and France."

## PYRITES.

The Canadian sulphur ore produced and used during the year amounted to 49,227 tons, which, taken at the current price of such ore for the year, i. e., $2.50 per ton, would have a value of $12,067.50. Production.

As in former years this production resulted from mining operations at the group of copper mines near Sherbrooke, P.Q., which have been fully described in the article on copper in this report.

A small proportion is used locally in the manufacture of acid at the works of Messrs. Nichols & Co., at Capelton, the rest all being shipped to the United States, where it is used for a similar purpose.

The amount of pyrites imported into that country during 1890, as given by the *Engineering and Mining Journal* of New York, was 115,000 tons, with an average of 43 per cent of sulphur.

The ore carries sulphur to the extent of 35 to 40 per cent, which is burnt off in the process of use, leaving only from 2 to 3 per cent in the residue.

In calculating from the returns received, only that portion of the ore shipped from these mines which was actually used in sulphuric acid manufacture, was included in the above total.

The ores of nickel and copper mined at Sudbury represent of course a very considerable amount of sulphur, but none of it becomes available for any useful purpose, being all dissipated into the surrounding atmosphere in the process of heap-roasting adopted, it having been decided after consideration of the subject by some of the companies that their ends would be better served than by erecting the very extensive and costly plant, which would be necessary to handle such large quantities of ore and utilize their sulphur contents, the profitable result of such a proceeding being also open to considerable doubt.

Imports.

The following table (No. 1) gives the imports of brimstone and crude sulphur, and illustrates the Canadian market for the same, which it is hoped may eventually be supplied, at all events partially, by pyrites of home production :—

PYRITES.

TABLE 1.

IMPORTS : BRIMSTONE OR CRUDE SULPHUR.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880 | 1,775,489 | $27,401 |
| 1881 | 2,118,720 | 33,956 |
| 1882 | 2,375,821 | 40,329 |
| 1883 | 2,336,085 | 36,737 |
| 1884 | 2,195,735 | 37,463 |
| 1885 | 2,248,986 | 35,043 |
| 1886 | 2,922,043 | 43,651 |
| 1887 | 3,103,644 | 38,750 |
| 1888 | 2,048,812 | 25,318 |
| 1889 | 2,427,510 | 34,006 |
| 1890 | 4,440,799 | 44,276 |

## SALT.

Returns of the production of salt are, as in previous years, made from Ontario and New Brunswick, and show a marked increase over the figures given for the year 1889. Outside of these two provinces no salt is made except in Manitoba and the North-West Territories where it is produced in small quantities by the Indians.

Ontario.

In Ontario the salt is obtained from beds at or near the base of the Onondaga formation, where it occurs inter-stratified with marls, dolomites and shales.

The following record of a boring made by Mr. H. Attrill, at Goderich, in 1876* may be taken as an index to the general character of the wells, which are sunk to various depths, ranging from 1,000 to 1,500 feet :—

| | Feet. | Inches. |
|---|---|---|
| Surface deposits | 78 | 9 |
| Dolomite with thin limestone layers | 278 | 3 |
| Limestone, with corals, chert and beds of dolomite | 276 | 0 |
| Dolomite with seams of gypsum | 243 | 0 |

---

*See Report of Progress, Geological Survey of Canada, 1876-77, pp. 226-227.

| | Feet. | Inches. |
|---|---|---|
| Variegated marls with beds of dolomite... | 121 | 0 |
| Rock salt, first bed...... ........ ...... ........ | 30 | 11 |
| Dolomite with marls towards the base...... | 32 | 1 |
| Rock salt, second bed.............................. | 25 | 4 |
| Dolomite................... ... .................. ..... | 6 | 10 |
| Rock salt, third bed.................................. | 34 | 10 |
| Marls with dolomite and anhydrite.......... | 80 | 7 |
| Rock salt, fourth bed. .......................... ........ | 15 | 5 |
| Dolomite and anhydrite.............................. | 7 | 0 |
| Rock salt, fifth bed..................................... | 13 | 6 |
| Marls, soft, with anhydrite........................ | 135 | 6 |
| Rock salt, sixth bed..................................... | 6 | 0 |
| Marls, soft, with dolomite and anhydrite... | 132 | 0 |
| Total depth........................................ | 1,517 | 0 |

It will be seen on reference to the above section that there is in a stance of 520 feet a total thickness of 126 feet of rock salt.

The salt is obtained in the form of brine, in most cases of full satura- on, the natural waters of the well acting as a solvent upon the salt ds.

The brine so formed is pumped into settling tanks, from whence there a constant stream feeding the evaporating pans. By reason of the adual dissolving away of the salt at the base of the well large cavities e formed into which the rocks constituting the roof of the cavity are ntinually falling, where owing to their marly and clayey composition ey are in a measure taken into mechanical suspension and pumped to the evaporating pans causing a slight falling off in the purity of e salt.

Regarding the quality of salt obtainable in Ontario, the following alysis conducted by Dr. T. Sterry Hunt, may not prove uninteresting. The salt chosen for examination was from the second bed in Mr. trill's well and gave the following results:—

Analysis of Goderich salt.

| | |
|---|---|
| Sodium chloride. ............................................ | 99·687 |
| Calcium do ................................................ | 0·032 |
| Magnesium do ...... ............... .... ............... | 0·095 |
| Sulphate of lime.......................... ........ ..... | 0·090 |
| Insoluble in water........ ....... ...................... | 0·017 |
| Moisture......... ......... ...... ........... ........... | 0·079 |
| | 100·000 |

Analysis of Cheshire salt.

Dr. Hunt in the report of the Geological Survey, 1876–77, compa this analysis with one made of the famous Cheshire rock salt in 18 the salt chosen for comparison being "crushed Marston rock sa manufactured by Messrs. Fletcher & Rigby.

The analysis shows a proportion of foreign matter equivalent to 2 per cent, as follows:—

| | |
|---|---|
| Sodium chloride | 96·70 |
| Calcium do | 0·68 |
| Magnesium do | Trace |
| Potassium do | —— |
| Sulphate of lime | 0·25 |
| Insoluble matter | 1·74 |
| Moisture | 0·63 |
| | 100·00 |

Comparison of various salts.

Again in the same report Dr. Hunt gives the following list of salt containing impurities, with the amount of foreign matter found in eac respectively:—

| | | |
|---|---|---|
| Cheshire salt (analysis above) | 2·67 | per cent. |
| Cordova, Spain, salt | 1·45 | do |
| Turk's Island salt | 2·34 | do |
| Saginaw salt | 2·00 | do |
| Syracuse solar salt | 1·15 | do |
| do boiled salt | 1·50 | do |
| Goderich coarse salt (analysis made in 1871) | 1·09 | do |
| Goderich medium salt | 1·28 | do |
| do fine salt | 1·62 | do |

It will be seen, therefore, that the salt produced in Ontario is of superior quality, ranging in amount of contained foreign matter from 1·09 per cent to 1·62 per cent, or an average of about 1·36 per cent.

No boring operations in search of salt were made during the past year, the only new feature in the trade being the erection of a block at Parkhill by Messrs. Hutchins & Co.

It is intended to make use of a well sunk some years ago by the Parkhill Salt Company, which, owing to the low price of salt prevailing at the time, was never put into service.

Producers Ontario.

operators during 1890 were:—

| | |
|---|---|
| Courtright | Courtright Salt Company. |
| Parkhill | Hutchins & Company. |
| Port Franks | Jos. Williams. |
| Exeter | Exeter Salt Works Company. |
| Hensall | Geo. McEwen. |
| Clinton | Henry Ransford. |
| Goderich | N. A. Chemical Company. |
| do | Ogilvies & Hutchison. |
| do | Peter McEwen. |
| do | Jos. Kidd, jr. |
| Warwick | Elarton Salt Works Company. |
| Wingham | Grey, Young & Sparling Co. |
| Blyth | do do |
| Kincardine | L. Rightmeyer. |
| do | Ontario People's Salt Company. |
| Brussels | T. T. Coleman. |

ing 1890 the industry was on a better footing than for the past ears, owing to the formation of a trust or combine of the various facturers under the title of the "Canada Salt Association." A r association was in existence from 1882 to 1885, when owing sension among the members, it was dissolved in the end of March, In the interregnum between that date and 1890 the industry fell atly, many of the works being closed, if not for the whole period, t for a very considerable portion of each year.

industry, notwithstanding the efforts of the producers, suffers y from its competition with English salt, which is admitted duty

the report of this Division for 1886, this point is alluded to llows: "Another thing which militates against the Canadian ndustr is the competition of English salt coming in duty free, with discriminatory freight rates in its favour. Even were emoved, there would remain the natural disadvantage of the ce of the chief market for salt in the Dominion, *i.e.*, the sea ies, from the centre of production, the cost of carrying the salt uch long distances doubling, or more than doubling, its price at int of consumption. The discrimination mentioned in favour of mpeting English salt arises from the fact that both the railways eamship lines can afford to carry material moving west at a very lower rate than that moving east. In fact, a large quantity of h salt comes out to Montreal as ballast, paying either none or a nominal freight charge."

New Brunswick.

In New Brunswick the salt production is as in previous years the result of the operations of the Messrs. Heinrichs, at Plumweseep, near Sussex, King's county, where a brine is obtained from natural springs that affords a very superior quality of dairy salt; the output being only sold locally and as such.

Production.

The quantity of salt produced during the year 1890 was 43,754 tons, having a net value of $198,897, an increase over last year of 10,922 tons and $69,350.

The production for the past five years is given below:

| | | | | |
|---|---|---|---|---|
| 1886 | 62,359 | tons, | valued at | $227,195 |
| 1887 | 60,173 | do | do | 166,394 |
| 1888 | 59,070 | do | do | 185,460 |
| 1889 | 32,832 | do | do | 128,547 |
| 1890 | 43,754 | do | do | 198,897 |

Exports and imports.

In the following tables will be found the exports and imports for the past eleven years:

SALT.

TABLE 1.

EXPORTS.

| Year. | Bushels. | Value. |
|---|---|---|
| 1880 | 467,641 | $46,211 |
| 1881 | 343,208 | 44,627 |
| 1882 | 181,758 | 18,350 |
| 1883 | 199,733 | 19,492 |
| 1884 | 167,029 | 15,291 |
| 1885 | 246,794 | 18,756 |
| 1886 | 224,943 | 16,886 |
| 1887 | 154,045 | 11,526 |
| 1888 | 15,251 | 3,987 |
| 1889 | 8,557 | 2,390 |
| 1890 | 6,605 | 1,667 |

SALT.

TABLE 2.

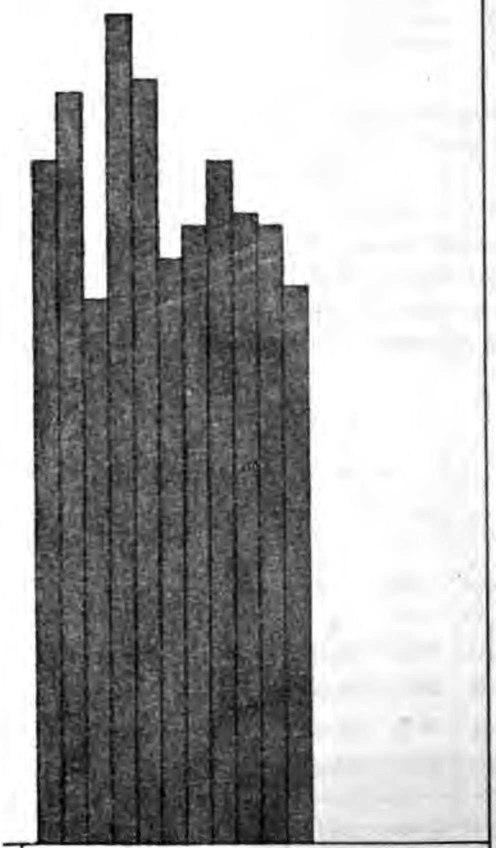
IMPORTS: SALT PAYING DUTY.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880 | 726,640 | $ 3,916 |
| 1881 | 2,588,465 | 6,355 |
| 1882 | 3,679,415 | 12,318 |
| 1883 | 12,136,968 | 36,223 |
| 1884 | 12,770,950 | 38,949 |
| 1885 | 10 397,761 | 31,726 |
| 1886 | 12,266,021 | 39,181 |
| 1887 | 10,413,258 | 35,670 |
| 1888 | 10,509,799 | 32,136 |
| 1889 | 11,190,088 | 38,968 |
| 1890 | 15,135,109 | 57,549 |

# SALT

## TABLE A

IMPORTS OF SALT ALL SORTS.



| | |
|---|---|
| 1880 | 106,720 |
| 1881 | 117,115 |
| 1882 | 84,932 |
| 1883 | 129,442 |
| 1884 | 119,081 |
| 1885 | 90,984 |
| 1886 | 96,236 |
| 1887 | 106,728 |
| 1888 | 97,338 |
| 1889 | 96,019 |
| 1890 | 86,813 |

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E. D. INGALL, M. E., IN CHARGE.

SALT.

TABLE 3.

IMPORTS: SALT NOT PAYING DUTY.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880.. .... ..... .... ....... . | 212,714,747 | $400,167 |
| 1881....... .... ............ | 231,640,610 | 488,278 |
| 1882........ ....... ......... . | 166,183,962 | 311,489 |
| 1883....... ...... ............ | 246,747,113 | 386,144 |
| 1884.................... . | 225,390,121 | 321,243 |
| 1885.... . ..... . ............ | 171,571,209 | 255,719 |
| 1886.. .... .. .. ........... | 180,205,949 | 255,359 |
| 1887... .... ... ........... .. | 203,042,332 | 285,455 |
| 1888............ ............ | 184,166,986 | 220,975 |
| 1889.. ............ ..... ..... | 180,847,800 | 253,009 |
| 1890... ...................... . | 158,490,075 | 252,291 |

the graphic table "A" opposite is given the total quantity of salt ted for the past eleven years, the quantity being given in tons.

SILVER.

total production of this metal for 1890 was 400,687 ounces, valued 20,722, as compared with 383,318 ounces, valued at $343,848 for This represents an increase of 17,369 ounces and $76,814. Production.

following table gives the relative contributions of the different nces to the total for the past four years, as given in previous ts, all showing an increase:—

SILVER.

TABLE 1.

PRODUCTION OF SILVER.

| EAR. | ONTARIO. | | QUEBEC. | | BRITISH COLUMBIA. | | TOTAL. | |
|---|---|---|---|---|---|---|---|---|
| | Ozs. | Value. | Ozs. | Value. | Ozs. | Value. | Ozs. | Value. |
| | | $ | | $ | | $ | | $ |
| .......... . | 190,495 | 190,495 | 146,898 | 146,898 | 11,937 | 11,937 | 349,330 | 349,330 |
| .... ...... | 208,064 | 208,064 | 149,388 | 149,388 | 37,925 | 37,925 | 395,377 | 395,377 |
| ........ . | 181,609 | 162,309 | 148,517 | 133,666 | 53,192 | 47,873 | 383,318 | 343,848 |
| .. ...... | 158,715 | 166,652 | 171,545 | 180,122 | 70,427 | 73,948 | 400,687 | 420,722 |

record of the progress and development in the various provinces g the year is given below.

re is nothing much to note with regard to this province. The Quebec. given represents, as formerly, the silver contents of the pyritous ores shipped from the mines in the vicinity of Capelton in the Eastern Townships district of Quebec. A gratifying addition was also made in the shipments of argentiferous galena from the Temiscamingue Mine up the Ottawa River. Further particulars regarding these two districts will be found in the articles on Copper and Lead.

Ontario

The silver from this province is, as formerly, the product of the mines in the vicinity of Thunder Bay, Lake Superior. As this district has been fully described in Part H, Vol. 1887-1888, and also alluded to in Parts S., Vols. 1886, 1887 and 1888, there will be no need to give the details of the mode of occurrence of the veins here.

The mines working at present are in two groups situated at distances of 20 and 32 miles from Port Arthur, on a line extending W. S. W. from that place. The chief producing mines of these two groups, known respectively as the Rabbit Mountain and Silver Mountain districts, are the Beaver, Badger and Porcupine mines in the former, and the Shuniah-Weachu and West End mines at Silver Mountain. Prospecting and development work has been prosecuted on a number of properties throughout the district as follows:—In the region north and west of Whitefish Lake preliminary work has been done on a number of properties as far west as Arrow Lake. In the Silver Mountain district work was prosecuted on the Crown Point, Silver Centre (R. 64) and Augusta properties, the latter being immediately west of the West End mine. In the Rabbit Mountain district some half dozen properties were working outside of the three producing mines, whilst further east in the township of Paipoonge, Neebing and McIntyre and east of Port Arthur along the line of the Canadian Pacific Railway, small forces of men have been at work on several properties.

A certain amount of work has also been prosecuted in testing veins at the headwaters of the Pine River, south of Silver Mountain, and at Cloud Lake towards the centre of the area of these silver-bearing rocks. These experiments are specially interesting, as they are in a part of the district which has been comparatively unexplored, owing to its inaccessibility, but where, for geological reasons, any veins found might be expected to have as good a chance of proving rich as in the other parts of the district. In fact, the greater thickness of the favourable black slates, which there is reason to believe will be found to characterise this vicinity would assure the favourable character of one set of the conditions necessary for the existence of payable ore in any fissures that may be discovered there.

The developments on the chief mines begin to assume considerable proportions. The No. 3 shaft at the Shuniah-Weachu mine, Silver Mountain, is said to be down 800 feet, whilst the greatest depth attained, so far, at the other end of the same vein, is said to be 225 feet in one of the shafts of the West End mine. Of the Rabbit Mountain group the most extensive developments are to be found at the Beaver mine which has attained a depth of 600 feet. These depths are, of course, measured from the tops of the shafts which are at various levels.

British Columbia.

It will be noted that the amount of silver produced and shipped from this province still continues to show an increase which amounts to 17,235 ozs., and $26,075 as compared with last year. These figures do not seem to be very exact, as the Report of the Minister of Mines for British Columbia, from which they were taken, states that they represent 110 tons of ore, valued at $409 per ton for both silver and copper, but that the relative value of each metal has not been made known. Thus this item may represent the value of a certain amount of copper.

The total amount of the silver produced as yet is not, of course, large, but from the promising nature of the districts, as reported by Dr. Selwyn, Dr. G. M. Dawson and other reliable authorities, there can be no doubt but that with the advent of better means of communication they will speedily become large contributors to the silver production of the country.

The districts of East and West Kootenay and Yale, constituting that part of the province bounded on the west and north by the Canadian Pacific Railway, on the east by the interprovincial and on the south by the international boundary, include the chief discoveries of silver, copper and lead bearing veins at present made.

The chief centres of activity at present lie in the Toad Mountain, Hot Springs or Ainsworth and Hendryx camps and the Illecillewaet subdivision of the West Kootenay district and the Cherry Creek and Rock Creek camps of the Yale district.

As mentioned in the articles on gold and copper, these veins so often show an intimate association of the ores of all these metals that it is impossible to definitely classify them under either one head or the other, so that for convenience the information about them is given here.

The silver produced in the province as above given was all the result of operations on the Toad Mountain and Hot Springs groups of veins.

The reports of the progress of mining in the various districts are reproduced below from the report of the Minister of Mines of the province for 1890.

The silver veins of East and West Kootenay are mentioned as follows:—

"*Illecillewaet Subdivision.*—Under the able superintendence of Mr. Jas. Brady, C.E., the tunnel in the Lanark is now over 500 feet long, 300 feet of which was completed this season. The lode in this claim is from

British Columbia.

2½ to 5 feet wide and of a high grade character. Sixteen car loads, shipped some three or four years ago, returned in silver alone 89 oz. to the ton. The company has expended a large amount of money in developing its property and is deserving of the utmost success.

"The Maple Leaf has two shafts sunk, one at the upper end of the claim 35 feet deep, the other at the lower extremity, 45 feet. The vein is 4½ feet wide. Returns from a previous shipment yielded 90 oz. in silver, $\frac{175}{1000}$ oz. gold, and 28 per cent lead. The Crystal adjoins the Maple Leaf on the west. In performing the assessment work on this claim last summer a solid body of good ore was struck, the width of which was not ascertained. A shipment of ore will be made to the sampling works to test its value.

"The Oak Leaf is owned by Messrs. Jowett and Haig, and with more work will probably become a valuable property. The vein is 2 feet wide, composed of galena in a slate formation. Assays range from 45 to 200 oz. of silver to the ton, and from 50 to 60 per cent lead.

"The Cariboo Company have extended their tunnel 100 feet farther this summer. The vein is galena, lying between walls of porphyry, and varies from 6 to 12 feet in width. The assay value is $30 per ton. This claim shows a large body of ore, which can be made very profitable on being provided with cheap transportation to the railway.

"The Gladstone is owned by Messrs. McArthur and Kennedy, of Illecillewaet. A shaft has been sunk 20 feet, and a tunnel run on the vein 30 feet; width of lode from 18 to 30 inches. The ore is of a high grade character. About 20 tons is on the dump ready for transportation by mule train.

"On Gold Hill are located the Cora, Spanish Fly, Crown Point, Vulture and some others. They are situated in a depression, about 12,000 feet long, which extends across the mountain. The vein matter is lead carbonates from 6 to 12 feet wide, possessing an assay value of 20 oz. in silver to the ton. A trail was constructed by the Government last summer, which starts from a point on the Cariboo Creek trail, about two miles east of Illecillewaet, and terminates at the above group of mines, a distance of about 5½ miles. This improvement will prove a great assistance to mining operations in that direction.

"The Goat Cave is located south of the railway track, back of the town of Illecillewaet, on the steep slope of a mountain. A specimen of the ore yielded an assay amounting to 120½ oz. in silver and 63 per cent lead. A tunnel is in about 20 feet on the lode, which is composed of quartz and galena. One half of the claim was sold last fall by the proprietors, Messrs. Scott and Chisholm, to Mr. Sando, of London, England. I did

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Learn the amount, but one of the conditions is that the sum of $4,000 xpended by the purchaser in development.

At Albert Cañon, the Wild Fox, owned by Abrahamson Bros., of elstoke, has a tunnel 47 feet long; vein matter is galena, 3 feet e; assay value 22 oz. silver to the ton, and 47 per cent lead. There two other locations of the same character upon which insufficient k has been accomplished to determine their value.

It is a matter of surprise to every one that the Illecillewaet sub- sion has not attracted more attention from capitalists and mining in general. Many of the veins are rich and well defined, exhibiting e bodies of ore, and possessing the great advantage of being situated hin easy reach of a railway, and, in some instances, quite close to this ns of transportation. It is, therefore, not owing to the absence of of these features that development has not been more actively pro- ited, but to the fact that here and elsewhere the majority of mine ners cannot afford the heavy expenditure required for that purpose, they demand too high a price for their property to secure the invest- nt of capital. Some of the richest mining sections in the adjoining tes have experienced similar periods of depression, ascribed to the e cause, until the capitalist was offered sufficient inducements to e to their rescue. It is evident that a more liberal course will have e pursued to attain the benefit of the great wealth lying dormant by means in the principal mining districts of the province.

*Fish Creek.*—The Dunvegan mine, which looked so promising last r, has remained idle since spring. The Kootenay Smelting and Trad- Syndicate had it bonded for the sum of $60,000 for three months. er the expiration of that time a further extension was demanded but sed, and work was discontinued.

The Mogul is an extension of the Dunvegan. It has a drift in the e 23 feet, exposing a fair body of high grade ore of the same character hat found in the last-mentioned claim.

*East Arm, Upper Arrow Lake.*—With the exception of assessment k little has been accomplished on the locations, about a dozen in ber. The Kootenay Smelting Company have done some drifting on of their claims without satisfactory results. The ore is rich, but the is broken and difficult to trace.

*Lardeau River Country.*—On the 29th of September J. W. Haskins rded at the Revelstoke office five mineral claims discovered by him e Lardeau country. They are situated about six miles east of Trout , and, judging by the assays, indicate the existence of a rich mineral in that direction. Specimens from the different claims were assayed

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by Mr. Rosser, the assayer for the Smelting Works, and gave the following returns :—Alice, 1st assay, 10 oz. gold, 50 oz. silver, 72 per cent lead, to the ton; 2nd assay, from different portions of the vein, 20 oz. silver, trace of gold, 40 per cent lead. Homestake, 0·86 oz. gold, 102 oz. silver, to the ton, 16 per cent lead; 2nd assay, from another portion of the lode, 75 oz. silver to the ton. Copper King, 11 oz. silver; no assay made to ascertain percentage of copper. Clara, 31 oz. silver to the ton; traces of gold.

"The discoverer, during an absence of several months, explored Fish Creek and the mountain ranges bordering on that stream, without finding anything worthy of attention. East of the lake mentioned, however, he detected the presence of mineral indications, which he followed, and led to the discovery of these ore deposits. The veins average from 2½ to 3 feet wide, and are about 18 miles from the head of navigation on the East Arm."

"*Toad Mountain Subdivision.*—On the west side of Cottonwood Creek, about three miles south of Nelson, is an important group of locations which will prove profitable to their owners when in a position to make shipments. The vein is between four and five feet wide, possessing an average assay value of $30 to the ton. The ore is capable of being concentrated. A shaft is sunk on the Lizzie Co. 38 feet deep, and one on the Umatilla and Uncle Sam, 40 feet. A drift has also been run on the two latter claims. These mines are well situated for transportation facilities.

"On the Sandy Creek slope of the mountain are some important locations, among which are the Toughnut and Evening. On the former a shaft has been sunk 80 feet, and a tunnel run 127 feet. The vein is from four to eight feet wide, and contains ore of a high grade character. This mine will be an ore producer next summer. A tunnel has been run in the Evening, which is an extension of the Toughnut, a distance of 137 feet, in addition to an incline 65 feet.

"On the Give Out slope are a number of mines, the principal ones being the following:—The Jim Crow, with a shaft 25 feet deep; the Dandy, a shaft 40 feet deep, which will be sunk to a depth of 100 feet this winter. The lode in this claim is changing from galena to grey copper, which returns high assays. The Grizzly Bear is opened up by a shaft 68 feet deep. The Iroquois, a tunnel 90 feet long. The Give Out, a shaft 30 feet. The Newmarket, a shaft 40 feet deep.

"All the foregoing mines show excellent bodies of ore of a high or medium grade character, which will be industriously worked with the advent of cheap transportation.

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'The celebrated Hall mines, comprising the Silver King, Kootenay nanza, and American Flag, are situated on the summit of Toad Moun-n. They would have employed a large number of men last summer d it not been for the litigation in which they were involved. The nel in the Silver King is 330 feet long, in which are employed four-n men. A large quantity of ore is on the dump awaiting the com-tion of the waggon road for shipment. One hundred and ten s of ore were forwarded last fall from this mine to Helena, Montana. was taken from a cross-cut at the bottom of the incline, and sampled m $404 to $414 to the ton in silver and copper.

" On the north side of the Kootenay River, the Alaska, a late discovery, located on a ledge over 30 feet wide, existing in a granite formation. e vein matter consists of dolomite, carrying galena and copper pyrites. e returns from the assays have not yet been learned.

" Assessment work merely has been done on the Copper Queen and her claims situated on the same side of the river.

"*Hot Springs Subdivision.*—Development in this subdivision has been rosecuted with diligence in the principal mines. The Skyline forwarded st fall 95 tons of ore to the smelter at Anaconda, which sampled 280 unces of silver to the ton. An engine has been erected for pumping and oisting purposes, and a shaft-house 70 by 31 feet. A contract for nking 200 feet has been awarded, besides 200 feet of cross-cutting and rifting. A pack trail has been graded from the waggon road to the ine, a distance of 10 miles. The Union has an engine erected on the round, and will sink to a depth of 200 feet. The Krao has also pump-g and hoisting works about ready for operation. The Number One ompany have struck the vein within fifteen feet of the bottom of their d incline. The ore is high grade and averages nearly four feet of lid ore. This claim was formerly considered a failure, but additional ork has proved it to be one of the best locations in the camp. The de will now be tapped and prepared for stoping.

"The Little Donald has changed hands, Mr. Stevens, of Spokane Falls, ing the purchaser. This year a deep tunnel will be started provided th the best improved machinery for the purpose.

"The Crescent, Eden, Tenderfoot, Vancouver, Old Timer and Neosha mpanies have all within a few weeks struck bodies of rich ore, carry-g native silver, and are sacking it for shipment. The Old Timer and nderfoot cover the intervening ground between the United and Krao, d demonstrate the permanent character of the ore body that extends rough this mineral belt.

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"The Maestro, Spokane, and Libby Companies are to drive their t nels this winter. These claims are certain to develop into first-cl properties. The contract for work on the Gallagher will be given t winter. The following work has been accomplished on the unde mentioned mines:—

| | Feet. |
|---|---|
| Skyline, incline and drifts | 490 |
| United, shaft | 60 |
| Gallagher, shaft and drifts | 220 |
| Krao, shaft and drifts | 350 |
| Fourth of July, tunnel and drifts | 100 |
| Union, shaft | 85 |
| Arkansas, shaft | 50 |
| Spokane, tunnel and drifts | 350 |
| Maestro, tunnel and drifts | 260 |
| Lady of the Lake, tunnel | 60 |
| Dictator, tunnel and drifts | 200 |
| Number One, tunnel and drifts | 1,200 |
| Lakeview, shaft | 25 |
| Little Donald, shaft and drifts | 250 |
| Black Chief, tunnel | 30 |
| Pataha, tunnel and drifts | 120 |

Besides many others having shafts and tunnels from 30 to 50 feet.

"The intrusion of a 'horse' in the Union shaft for a time prevente satisfactory results. Since then the vein has assumed its proper position and now looks as well as ever.

"The amounts of ore on the dump ready for shipment, which will b largely increased during this winter, are as follows:—The Skyline, 1,00 tons that will return 45 ounces to the ton; United, 1,200 tons; Krao, 1,00 tons; Number One, 2,000 tons, besides 50 tons of high grade. Th quantity sacked by other companies has not been learned.

"*Hendryx mines.*—Development in the Blue Bell mine has bee steadily carried on under the management of Dr. Hendryx. The tunn and drifts have attained an aggregate length of 1,500 feet. The wor accomplished last year has only corroborated the knowledge previousl obtained as to the apparently inexhaustible supply of ore in this valuabl property. I have been informed that the adjoining extensions, two i number, have been purchased from Mr. Ainsworth for the sum $100,000. This will necessitate the construction of a smelter to rend the large body of mineral wealth controlled by the Hendryx Compan available.

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“ *Goat River.*—The Goat River mines are situated about eight miles rth of the boundary line. They were discovered about the latter end July, by James King. An Indian happened one day to show him a ece of float he had found, which Mr. King recognized to be rich. The tter at once instituted a strict search, which was rewarded by iding the lode whence it had been detached. The ore is galena, ree feet on the surface, and assaying from $30 to $80 in lver to the ton. A tunnel 125 feet long has tapped the vein at a pth of 100 feet, which, at the point of intersection was found to be x feet wide. Twelve locations have been recorded. These mines are tuated within four miles of the Kootenay River, and will enjoy the lvantages resulting from cheap transportation. They will attract a umber of men next summer. Anticipating the importance this camp ill attain, the Government has lately appointed a gentleman residing the vicinity to discharge the duties of a mining recorder.

“ *Trail Creek.*—Trail Creek is situated on the west bank of the Columbia ver, about 20 miles below Sproat, and 10 miles north of the 49th parlel. The mines are scattered over an extent of country extending back om the river from three to eight miles, including Red Mountain, which ntains some of the most promising locations. One hundred and sixteen aims have been recorded, which are divided into two distinct groups, e smaller one, containing about forty locations, possesses veins from vo to ten feet wide, assaying as high as $180 in the precious metals, lver predominating; the vein matter also carries lead, zinc and antiony.

“The principal mines in this belt are the Lily May, Zwiloo, Blossom nd Homestake. A shaft in the Lily May at the depth of 20 feet shows vein four feet wide, carrying about 80 ounces of silver to the ton, oice pieces running up to 180 ounces. The Zwiloo also shows up ually as well, and is considered one of the best locations in the camp.

“The larger group commences about two miles north of the first menoned. Copper and iron are here the most widely disseminated ores. ith a little antimony, more or less gold, and a small quantity of silver, cross-cut in the vein of the Le Roi exposes a solid body of ore 18 feet ide, which will run about 8 per cent copper, 10 ounces in silver, and aries from $3 to $500 in gold to the ton. A part of this mine has been nded by a Spokane Falls company, who are steadily working it with vo shifts of men. There is every probability this will turn out to be first class mine. Three other locations on this vein exhibit similar vourable indications. The St. Elmo, Mountain View and Spar have en bonded by Portland, Oregon, capitalists. These are the only ims that possess galena veins. Six or seven others are under bond,

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but work will not be actively carried on before the approach of spring. The Josie, owned by R. E. Lemon, which returned large assays, was also bargained for, but I have not learned whether the bargain was effected.

"The ore bodies in this district exist in a syenite formation, and are generally capped with iron rock. Some of them are of great width, varying from four to fifty feet, and cut the stratification of the rock at right angles. Their general course is east and west, with the exception of the Lily May, and its extensions, which runs north-east and south-west. Excellent facilities for shipping are provided by the easy access to the Columbia River, whence freight can be cheaply transported to Revelstoke, or the Dalles, where connection can be made with the Spokane and Northern Railway.

"The belief is entertained that with the attaining of greater depth copper will be found in paying quantities. This has proved to be the case in the Le Roi, the copper having increased from seven per cent on the surface to fifteen per cent at a depth of ten feet; also a perceptible improvement in the quantity of silver. The surrounding country presents an inviting appearance to the eye, consisting of level benches, covered with grass and timber. The latter is open and affords no obstacle to prospectors.

"The climate is mild and agreeable, and the snowfall amounts to only nine or ten inches in depth. About fifty men will winter there this year. A mining record office has been established, which is a great convenience to miners, who, previously, had to undergo the loss of time and expense incurred in travelling to Nelson on business connected with their claims."

*East Kootenay.*—The particulars of progress, &c., in this district are reported as follows:—

"The mineral of the district, as far as at present ascertained, lies in two main belts. The mineral at Ottertail and Field, in the Rockies, appears to be local, no continuation of large extent having been traced. The first of these belts commences in the Selkirk Range, at the head of the North Fork of the Spillemcheen River, near Mount Sir Donald, and runs thence in a south-easterly direction on the easterly slope of the Selkirks, passing through the McMurdo district, including Cariboo Basin, Carbonate Basin, and cutting McMurdo Creek, Copper Creek, Vermont Creek, Horse Thief Creek, Toby Creek, &c., gradually approaching the Columbia valley and passing into the Rockies to the south of the Columbia lakes.

"The minerals discovered up to the present in this belt are gold in sulphurets (free milling at the surface), silver-bearing galena and grey copper, antimony, bismuth and other minerals occurring casually.

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The minerals of this belt are *high grade*, especially the grey copper l antimonial copper ores, assays as high as 1,024 oz. to the ton having n obtained. Test lots of ore, amounting to about 50 tons, shipped last son from the neighbourhood of Vermont Creek, gave excellent results.

The second important belt, mentioned above, runs about parallel to Selkirk mineral belt, generally in the limestones and quartzites at or se to their contact with the slates (Cambrian) of the Selkirk forma-ı, along the valley of the Columbia southwards, crossing the valley l passing into the Rockies near the Columbia lakes. The discoveries in s belt are probably some of the most important of the district, though continuous than those of the Selkirk belt, viz.: Jubilee Mountain, illemcheen Mountain, Steamboat Butte, Windermere Mountain, and ious promising discoveries of copper ore in the Hughes Range, east the Kootenay River. The bulk of the ore so far extracted is of copper l lead, carrying silver. Some high assays in silver and gold have been tained principally from Jubilee Mountain.

"The Field discoveries, of which the 'Monarch' mine is the most im-rtant, also those in the neighbourhood of Ottertail, both quite close to Canadian Pacific Railway in the Rockies, would appear to be more al in their character, no continuous belts having been traced for any nsiderable distance.

'The region down the Columbia to Canoe River, north of the railroad, s not yet been prospected for quartz.

'*Field.*—The 'Monarch' mine, situated on Mount Stephen, near the nmit of the Rockies, a quarter of a mile from and at an elevation of ) feet above the Canadian Pacific track, is at present the only fully ıipped working mine in the district. The company has resumed rk this fall. A force of ten miners is now at work, terms having been anged to supply the Revelstoke Smelter Company with 200 tons of per month. The shipping ore averages about 60 per cent lead with " (ozs.?) "of silver to the ton.

'The ore occurs in somewhat irregular chambers, pockets and other posits in the limestone, with but little gangue, and seems abundant. is expected that the mineral will lie in more regular form and even eater body when more depth into the mountain has been reached. ıe mine was discovered in 1884. About 1,500 tons of ore have been tracted and shipped up to the present time. The underground work-gs amount in the aggregate to about 450 feet of tunnelling, with larger ambers opened out in places where ore was more abundant. A con-lerable amount of work has also been executed on the outside, consist-g of a tramway, galleried out of the face of the mountain, leading to

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the principal ore bins, and a gravity road from thence to the bins on the railroad, together with all the necessary plant for working the mine.

"On the various other claims in the vicinity of Field, little more than prospecting and assessment work has been done, though some of the prospects look as favourable as the 'Monarch' did before it was opened up.

"The ores so far found in the locality have been very pure galena ores, low grade in silver, containing occasionally a small percentage of zinc.

"*Ottertail.*—No work of consequence has been done in this locality for several years.

"*Selkirk Mineral Belt, including McMurdo District.*

"*Cariboo Basin.*—On the north side of the Middle Fork of the Spillemcheen, or McMurdo Creek, on which a number of claims, showing good croppings, have been located, has not received much development work this season beyond assessment work on some of the claims.

"*Carbonate Mountain*—On the south side of McMurdo Creek, has many important claims. Messrs. Rand Bros., of Vancouver, on behalf of English capitalists, purchased a property of ten claims in the fall of 1889, to which they have added other locations. The most important of these prospects, showing on the surface, occur on the 'Monitor,' 'Southern Cross' and 'Polly Brown' claims. The previous development done on these claims was unimportant. The vein can be traced continuously along the whole length of the property, extending from McMurdo Creek along the summit of Carbonate Mountain into Copper Creek. This main lead, like most of the mineral in the belt, runs in a south-easterly and north-westerly direction, lying almost vertically between walls of slate, mica-schist and granitic rock. The width of the vein on the surface is estimated as varying from 2 to 5 feet, fairly well mineralized. The property was examined by Mr. Giffard, the well known English expert, in the summer of 1889, in the interest of Messrs. Rand Bros., prior to their purchase, whose report, of course a private one, was understood to be favourable. Messrs. Rand Bros. have been actively at work since that time prospecting their property, and are at present engaged in driving a tunnel and cross-cut from McMurdo Creek, which is expected to cut the lead at a depth of 2,500 feet from the croppings along the top of the mountain. From the latest reports the tunnel was in 300 feet and the cross-cut commenced. The ore of the croppings is composed of sulphides of lead, iron and antimony, averaging about 50 oz. to the ton of silver.

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bout three miles further up McMurdo Creek from the above line
ms, near the summit of the range, a number of claims have been
d, amongst the most important of which are the 'Bobby Burns'
Chief of the Selkirks,' the original discovery claims of the locality.
work has been done heretofore on these. The 'Bobby Burns'
ns a large vein of gold quartz, free milling on the surface. A
ıp mill has been purchased by the owners, and is now at Golden
rk on this claim next summer. Gold is visible in some of the sur-
ıck, and assays of 35 oz. of gold have been obtained.

ıe 'Chief of the Selkirks' and adjoining claims at the summit con-
alena and grey copper ores.

ontinuing south-eastward from the Carbonate Mountain claims,
en Copper Creek and the South Fork of the Spillemcheen, several
have been located on which only assessment work has been done.
are favourably reported on. On the southern slope of this divide,
ıg down into Vermont Creek, occur the 'Dark Horse,' the
s,' and the 'Syenite Bluff.' A 6-ton sample lot of galena ore
ıipped from the Dark Horse claim last summer, also a shipment
he Agnes claim. Both gave very favourable results.

n the south side of Vermont Creek, near its junction with the
Fork, a block of claims, discovered in the summer of 1889, con-
number of veins of galena and grey copper, about ten in number,
ıg in width from 2 inches to 20 inches, in the slate formation. It
sidered that these veins will in some cases run together. Thirty
ons of ore were packed out on horses from these veins to the
ıbia River, a distance of about 21 miles, thence by steamboat to
n and by rail to Revelstoke, realizing, under all these difficulties,
lsome profit to the owners. The ore was pronounced to be of
ent quality at Revelstoke.

ood prospects have been located further south, on Crystal Creek
ugaboo Creek in the same belt. The country between this point
Iorse Thief Creek has been but little prospected. In this latter
y, and on Toby Creek, very promising new discoveries were made
eason and a number of claims recorded. The 'Little Fellah'
on Horse Thief Creek, is described by a reliable and disinterested
as a magnificent prospect. It is stated to be a well-defined lode
slate, about 20 feet in width. Assays from 20 to 50 per cent of
and 20 to 100 oz. of silver have been made. Several other good
prospects have been located on this creek.

ew discoveries, stated to be large veins, containing high grade
, are also reported from about 20 miles up Toby Creek.

### "*Mineral Locations along the Columbia Valley Belt referred to in General Description*" (*pp.* 176–179).

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"*Jubilee Mountain*—situated about 42 miles up the Columbia River from Golden, on the Canadian Pacific Railway, has mineral claims located along its ridge and western slope for a distance of over four miles. About 30 tons of copper glance and carbonates of very fine quality, averaging 55 per cent copper, were shipped from the 'Lancaster' claim, owned by John McRae, during last summer to Swansea, as a sample lot, by C. F. Law, agent for Toronto capitalists. A good body of silver-bearing galena ore has been opened up on the 'Constance' claim this winter, and development work on a large scale is looked forward to in the spring. The claims on which most development work has been done are the 'Constance,' 'Lancaster,' 'Horseshoe' and 'Alice.'

"*Spillemcheen Mountain.*—A considerable amount of work has been done on various claims on this mountain during the past few years. Messrs. Wells and Pollock have been at work this winter driving a tunnel to reach the 'Big Lead,' understood to lie at the contact between the lime quartzite and the slate, at a low depth.. They have drifted altogether 260 feet up to date, and expect to cut the lead within 20 feet further. The results of other prospecting work recently done on the mountain have been very favourable; a large quantity of ore has been taken out. The claims showing most development work are the 'Spillemcheen,' 'Homestake,' 'Rothschild,' 'Tiger' and 'Eureka.'

"*Windermere Mountain*—situate about four miles north of Windermere, on the Lower Columbia Lake, has been drawing much attention during last summer. Mr. O. A. Brown, of Spokane, became interested in claims on this mountain in July last, and has been actively developing with excellent results, having exposed a large body of copper glance and carbonates. He has from 75 to 100 tons of ore on the dump at present, and expects to make some shipments in the spring. Two shafts, 40 feet and 20 feet respectively, have been sunk, and a tunnel to tap the lead in depth is contemplated. The ore consists of copper glance, carbonates and red oxides. A large number of assays have been obtained, ranging from 10 to 80 per cent in copper, and from $3 to $130 in silver, to the ton. Two principal ore bodies have been cut through, one 18 feet in width, the other 7 feet. There are fourteen claims taken up in this locality. Some of these promise to prove valuable.

"In the neighbourhood of Wild Horse Creek some development has been done on a galena ledge about three miles above the old camp. It would appear that a large quantity of concentrating ore, carrying silver, has been met with.

"Prospectors have brought in samples of ore from about 25 miles up Wild Horse Creek, which are stated to have assayed $225 in gold, silver and copper.

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"The discovery of a new mineral district is reported about 11 miles in a south-easterly direction from Fort Steel. A sample from this locality assayed: gold, $96; silver, $300; and copper, 12 per cent."

From Yale district the following items are reported:—

"*Yale Creek.*—The owners of the Queen silver mine, in which extensive tunnelling and sinking has been done, still persevere at heavy outlay to develop their property, from which very rich prospects in silver have been obtained, assaying as high as $500 in silver and $140 per ton in gold.

"*Silver Peak, near Hope.*—The Eureka and Victoria Companies have not been carrying on work of late years, but I am pleased to say the company (composed of wealthy Victorians) has been remodelled in the past year, with a view to resume vigorous operations next season. Rich assays have been obtained from these mines, ranging from $100 to $800 per ton in silver.

"*Stump Lake Mines.*—This locality was fully reported upon last year. During the past twelve months, assessment work has been done on a number of claims, but I regret to say that the Nicola Milling and Mining Company have, for the present, discontinued working their mines. It is expected, however, that they will resume operations early next spring. No new discoveries of quartz have been made during the past season.

Dr. Dawson in his Summary Report to the Director of the Geological Survey for 1890, speaks of these mines thus:—

"The metalliferous deposits in the vicinity of Stump Lake referred to in the Summary Report for 1888 (p. 8) and in the Mineral Wealth of British Columbia (p. 69 R) notwithstanding the favourable conditions for their development and the high assay value of some of the ores, have not yet assumed a position of permanent importance. The Nicola Mining and Milling Company have now sunk in the 'Joshua' shaft to a depth of about 400 feet, and have done considerable drifting, for the purpose of exploration, but with this exception 'assessment work' only has been carried out on the various claims taken up in this vicinity. The general parallelism and the evident connection of the veins of this locality with the outline of the great granitic area to the west rendering it important that this should be done, the remaining part of the line of contact of this granite with the stratified rocks was traced in detail. The vicinity of this line of contact, like that of several other similar contact lines and numerous places not distinctly connected with granitic masses, is characterized by a great abundance of vein quartz. Many sp of such veins have been collected for the purpose of assay, the r which it is hoped will afford some definite information as to the and mode of occurrence of the gold and silver ores."

In the Similkameen sub-division very little was done in quartz the owners of mineral claims having satisfied themselves with performing the necessary work to hold their locations.

Prices.

The appended graphic table A opposite, shows the prices obta the metal during the year. The very considerable fluctuations w to the legislation, actual, and proposed by the United States Gove looking to the enforced purchase by the Treasury Department of 4 ozs. of the metal each month, and the consequent operations o lators.

Exports.

The export figures of this metal as found in the books of the ( Department, are given in Table 2 below:—

SILVER.

TABLE 2.

EXPORTS OF SILVER ORE.

| Province. | 1886. | 1887. | 1888. | 1889. |
|---|---|---|---|---|
| Ontario. . . . . . . . . . | $16,505 | $184,763 | $208,064 | $203,871 |
| Quebec. . . . . . . . . . . . | 8,000 | 450 | 5 | 2,500 |
| Nova Scotia . . . . . . . | . . . . . . . . | . . . . . . . . | . . . . . . . . | 50 |
| Manitoba . . . . . . | 1,452 | 3,741 | . . . . . . . . | 5 |
| British Columbia. . . . | . . . . . | 17,331 | 10,939 | 5,737 |
| Totals . . . . . . . . | $25,957 | $206,285 | $219,008 | $212,163 |

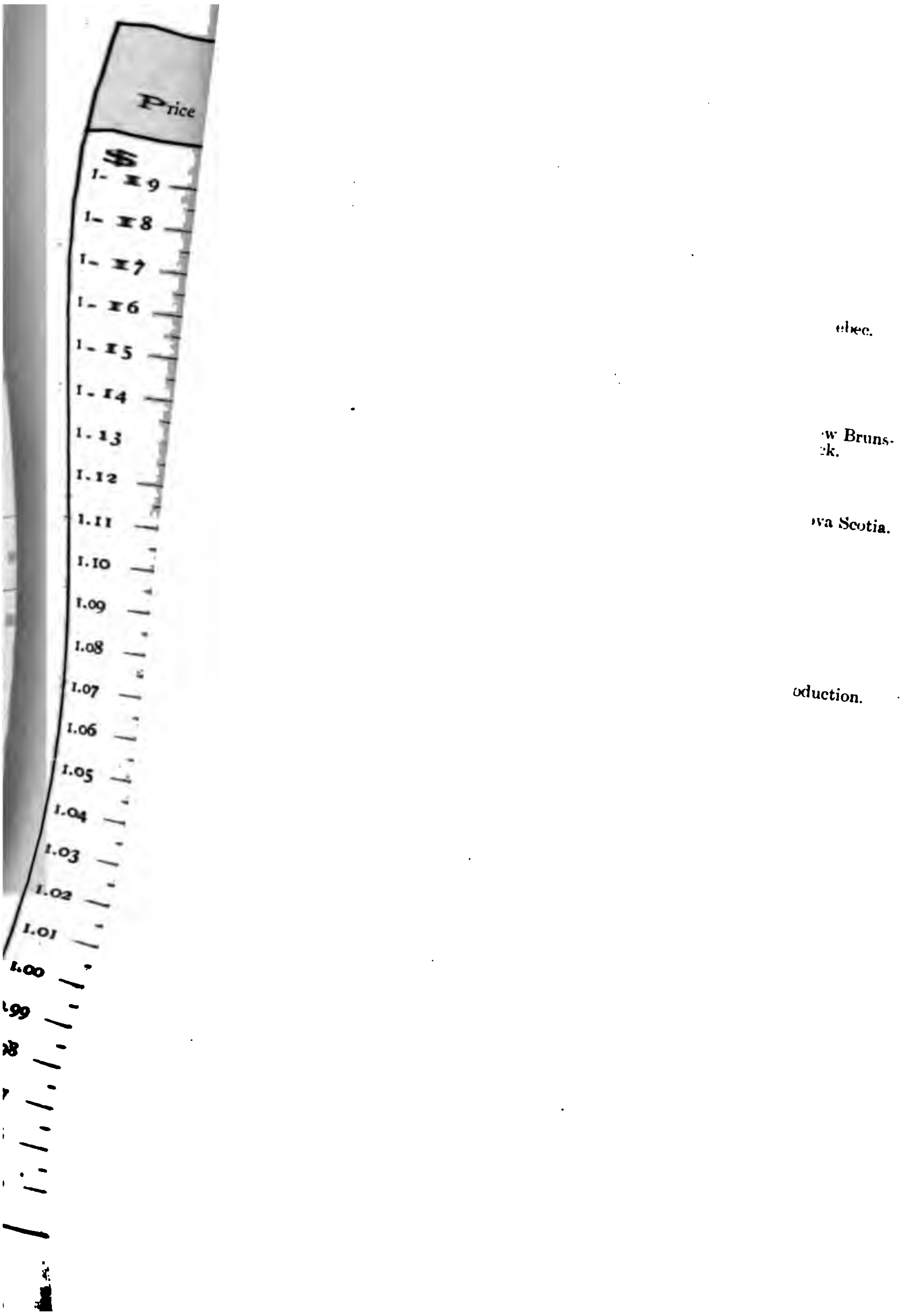
## STRUCTURAL MATERIALS.

Building stone.

*Building stone.*—No new features were noticeable in the trade past year, the industry being carried on in the same lines as i previous, with the exception, possibly, that the various varieties shipped to more distant points and not as before used almost alt locally. For example, a very considerable quantity of New Br sandstone now finds a market in Montreal, Toronto, Hamilton ar western cities, while stone from the quarries near Credit For county is delivered as far east as Montreal.

Ontario.

In Ontario the production has been somewhat less than in 188 to the fact that in several of the largest buildings erected dur


Price
$
1.19
1.18
1.17
1.16
1.15
1.14
1.13
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1.09
1.08
1.07
1.06
1.05
1.04
1.03
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ebec.
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ck.
va Scotia.
oduction.

Prices.

Exports.

Building stone.

Ontario.

New Brunswick or Ohio stone has been used and also that considee quantities of ornamental terra-cotta and pressed bricks are now in the erection of large buildings. The points of greatest producwere as in years previous in the vicinity of Caledon township, Peel ty, the Niagara escarpment between Hamilton and Queenston in tworth and Lincoln counties, and Belleville, considerable quantities being obtained at Owen Sound, St. Marys, Amherstburg, Elora, ston, Cornwall, Ottawa and Pembroke. ·

**Quebec.**

Quebec large quantities of limestone are quarried in the vicinity ontreal and between that place and Terrebonne; at Hull, Ottawa ty, and at many points on the north side of the St. Lawrence river. stone is obtained in considerable quantity at Chateau Richer.

**New Brunswick.**

New Brunswick the most important quarry is the "French Fort ry" near Newcastle, Northumberland county, the other large quar- eing in the south-eastern part of Westmoreland county.

**Nova Scotia.**

Nova Scotia a considerable quantity of stone is raised throughout berland and Pictou counties, a very large proportion of which is in the repairing of railway works and in the construction of the necto Ship Railway.

e stone quarried in Prince Edward Island and the Western Prov- amounts to but little, and is almost entirely used locally.

**Production.**

e production for the year, as returned to this office, is given in the wing table, which shows an increase over similar returns for 1889 ,226 cubic yards and $51,092.

STRUCTURAL MATERIALS.

TABLE 1.

PRODUCTION OF BUILDING STONE.

| Province. | No. of Returns | Cub. Yards. | Value. |
|---|---|---|---|
| Ontario | 47 | 113,465 | $347,252 |
| Quebec | 30 | 217,595 | 456,703 |
| Nova Scotia |  | 37,835 | 92,211 |
| New Brunswick | 10 | 8,934 | 54,697 |
| Prince Edward Island | 1 | 140 | 180 |
| Manitoba | 2 | 2,098 | 5,140 |
| North-West Territories | 3 | 2,496 | 8,600 |
| Totals | 93 | 382,563 | $964,783 |

As there are many small producers in Canada who cannot be rea or who have failed to make returns, these figures are not complete are supposed to represent about four-fifths of the production; assu that such be the case, there was a production during 1890 of 480,000 cubic feet, having an approximate value of about $1,200,00

Exports and imports.

The following tables show the exports of wrought and unwro stone and marble, and the imports of building stone and manufactur stone :—

STRUCTURAL MATERIALS.

TABLE 2.

EXPORTS OF STONE AND MARBLE, WROUGHT AND UNWROUGHT.

| Province. | 1889. | | 1890. | |
|---|---|---|---|---|
| | Wrought. | Unwrought. | Wrought. | Unwrou |
| Ontario | $ 3,422 | $ 271 | $ 7,284 | $ 6 |
| Quebec | .............. | 391 | 53 | 1 |
| Nova Scotia | 2,714 | 1,060 | 252 | 16 |
| New Brunswick | 15,226 | 26,482 | 13,649 | 11 |
| Manitoba | .............. | .............. | .............. | |
| British Columbia | 12 | .............. | 487 | 7,4 |
| Totals | $21,374 | $28,204 | $21,725 | $43,61 |

STRUCTURAL MATERIALS.

TABLE 3.

IMPORTS OF BUILDING STONE.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $ 35,970 |
| 1881 | 58.149 |
| 1882 | 33,623 |
| 1883 | 35,061 |
| 1884 | 51,088 |
| 1885 | 30,491 |
| 1886 | 41,675 |
| 1887 | 54,368 |
| 1888 | 86,373 |
| 1889 | 100,314 |
| 1890 | 132,155 |

### STRUCTURAL MATERIALS.

### TABLE 4.

### IMPORTS OF MANUFACTURES OF STONE OR GRANITE, N. E. S.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $29,408 |
| 1881 | 36,877 |
| 1882 | 37,267 |
| 1883 | 45,636 |
| 1884 | 45,290 |
| 1885 | 39,867 |
| 1886 | 41,984 |
| 1887 | 41,829 |
| 1888 | 47,487 |
| 1889 | 61,341 |
| 1890 | 84,396 |

**Canadian market.**

uring the past year Canada afforded a market for building stone of ıt $1,350,000, as follows:—

| | | |
|---|---|---|
| Production | $1,200,000 | |
| Imports of building stone | 132,155 | |
| Imports of stone and granite | 84,396 | |
| | | $1,416,551 |
| LESS—Exports, wrought stone | $ 21,725 | |
| Exports, unwrought stone | 43,611 | |
| | | 65,336 |
| | | $1,351,215 |

ıe production of building stone for the past four years, according to ɜt returns, and supposed to represent approximately the same pro- ion to the total output as do the figures for 1890, is as follows:—

| | | |
|---|---|---|
| 1886—165,777 | cubic yards | $642,509 |
| 1887—262,592 | do | 552,267 |
| 1888—411,570 | do | 641,712 |
| 1889—341,337 | do | 913,691 |

**Marble production.**

*arble.*—The production for 1890 amounts to 780 tons, valued at 776, and is altogether from Ontario. The output for the past four s has been as follows:—

| | | |
|---|---|---|
| 1886—501 | tons, valued at | $9,900 |
| 1887—242 | do | 6,224 |
| 1888—191 | do | 3,100 |
| 1889— 83 | do | 980 |

otwithstanding the many extensive deposits throughout Canada, e particularly in the pre-Cambrian areas of the Eastern Townships of

Quebec and the Laurentian areas of Hastings, Frontenac and other counties in Ontario, no work to any extent was performed, with the exception of that necessary to extract the above small amount, which was produced at Arnprior and Renfrew, Ont.

During the year operations were begun on a band of Huronian limestone, affording a handsome banded marble, near the Garden River Settlement, about ten miles east of Sault Ste. Marie. Only development work was done and no shipments were made.

**Imports.**

The following table shows the imports of marble, all sorts, since 1880; there were no exports reported as such :—

STRUCTURAL MATERIALS.

TABLE 5.

IMPORTS OF MARBLE.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $ 63,015 |
| 1881 | 85,977 |
| 1882 | 109,505 |
| 1883 | 128,520 |
| 1884 | 108,771 |
| 1885 | 102,835 |
| 1886 | 117,752 |
| 1887 | 104,250 |
| 1888 | 94,681 |
| 1889 | 118,421 |
| 1890 | 99,353 |

**Granite production.**

*Granite.*—The production of granite during 1890 amounted to 13,307 tons, valued at $65,985 at the quarry. This shows an increase in quantity over the previous year of 2,152 tons, while the value has decreased to the extent of $13,639.

The following figures show the production for the past four years:—

| | | |
|---|---|---|
| 1886—6,062 | tons, valued at | $ 63,309 |
| 1887—21,217 | do | 142,506 |
| 1888—21,352 | do | 147,305 |
| 1889—10,197 | do | 79,624 |

Of the production for 1890, the following subdivision may be made to show the production of provinces :—

| | | |
|---|---|---|
| Nova Scotia, | 2,000 tons | $ 9,200 |
| New Brunswick, | 5,195 do | 33,224 |
| Quebec, | 2,870 do | 14,200 |
| Ontario, | 3,242 do | 9,361 |

will be seen on reference to the above that the granite raised in ario is quoted at less than $3 per ton; subtracting the amount ited to that province the remainder has a value of about $5.60 per

This value, although less than that of 1889, is believed to represent e closely the net price *at the quarry*.

*late.*—The production of this material for 1890 is altogether that the province of Quebec, no slate being quarried elsewhere in the ainion. Slate

he area from which this production is reported lies in the three town- s of Melbourne, Cleveland and Shipton in Richmond county, Quebec, rein the more important slate bands are found. To the south of Rich- d, the production consisted almost altogether of roofing slates, tels and slabs for sinks, billiard tables, &c., while to the north of that e large quantities of school slates are annually produced, though ng 1890 a considerable proportion of the production of that district in the form of roofing slate.

e following data are furnished by the new Rockland Slate Company, g the results of tests of their product, and will illustrate the quali- of the slate of this district:—

*ysis made by B. J. Harrington, B. A. Ph. D., Professor of Chemistry, Mineralogy, &c., McGill University.*

| | |
|---|---|
| Silica | 65·39 |
| Alumina | 15·97 |
| Ferrous oxide | 4·66 |
| Manganous oxide | 0·39 |
| Lime | 0·67 |
| Magnesia | 2·99 |
| Potash | 3·60 |
| Soda | 3·33 |
| Loss by ignition | 3·26 |
| | 100·26 |
| Specific gravity | 2·75 |

*Tests*

at the Testing Laboratory of the Bridge Company, Lachine, P.Q., on an Emery Testing Machine:

*Test. Crushing.*—Strain perpendicular to lamination.

A 2″ cube failed at 108,570 lbs. = 26,574 lbs. per square inch.

*l Test. Crushing.*—Strain perpendicular to lamination.

A 2″ cube failed at 129,880 lbs. = 32,069 lbs. per square inch.

3rd *Test. Crushing.*—Strain parallel to lamination, but perpendicul grain, *i.e.*, edgewise.

A 2″ cube *was not crushed* at 151,000 lbs. = 36,531 lbs. per sq inch.

4*th Test. Breaking.*—Strain perpendicular to lamination.

A piece of slate 3′ long 4″ wide and 1″ thick on bearers 30″ a failed by splitting at 950 lbs. Modulus of rupture 10,000.

A beam 12″ long 1″ square, supported at both ends and load in the centre, fails at 556 lbs.

5*th Test. Breaking.*—Strain perpendicular to lamination.

A piece of slate 3′ long 4″ wide and 1″ thick, on bearers 30″ a failed by splitting at 1,092 lbs. Modulus of rupture 11,6

A beam 12″ long 1″ square, supported at both ends and lo in the centre, fails at 558 lbs.

Deflection with pressure at 690 lbs. was $\frac{7}{10}$ of 1″

Production.

The amount produced during the year was 6,368 tons, having a value of $100,250, showing a decrease from 1889 of 567 tons and $18, The production for the past four years is as follows:—

| | | |
|---|---|---|
| 1886—5,345 | tons | $ 64,675 |
| 1887—7,357 | do | 89,000 |
| 1888—5,314 | do | 90,689 |
| 1889—6,935 | do | 119,160 |

Exports and imports.

As may be seen on reference to the following table the market almost entirely a domestic one, small quantities only being exported:-

STRUCTURAL MATERIALS.

TABLE 6.

EXPORTS OF SLATE.

| Year. | Tons. | Value. |
|---|---|---|
| 1884 | 539 | $6,845 |
| 1885 | 346 | 5,274 |
| 1886 | 34 | 495 |
| 1887 | 27 | 373 |
| 1888 | 22 | 475 |
| 1889 | 26 | 3,303 |
| 1890 | 12 | 153 |

following table shows the imports during the past eleven years:—

### STRUCTURAL MATERIALS.

### TABLE 7.

### IMPORTS OF SLATE.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $21,431 |
| 1881 | 22,184 |
| 1882 | 24,543 |
| 1883 | 24,968 |
| 1884 | 28,816 |
| 1885 | 28,169 |
| 1886 | 27,852 |
| 1887 | 27,845 |
| 1888 | 23,151 |
| 1889 | 41,370 |
| 1890 | 22,871 |

Flagstones.

*stones.*—The production of flagstones during 1890 was alto-
that of Dudswell and Brompton townships in Wolfe and Richmond
s, Quebec, from the various quarries of which a small quantity of
ior quality of stone is shipped for flagging. Returns were not
d of any stone produced in Ontario for this purpose, though it
ved that considerable quantities of limestone were sawn to dimen-
r flagging.

use of flagtones has been lessened of late years by the introduction
nolithic" and other artificial pavements, which are being laid in
ities at a much less cost than flagging, and apparently meeting
requirements of natural stone, so that the market has not in-
l as much as might be expected.

Production

production for 1890 was 17,865 square feet, valued at $1,643,
shows when compared with the year previous an increase of 3,865
feet and $243. The production during the past four years was:—

| | | |
|---|---|---|
| 1886— | 70,000 (?) feet | $ 7,895 |
| 1887— | 116,000 do | 11,600 |
| 1888— | 64,800 do | 6,580 |
| 1889— | 14,000 do | 1,400 |

Imports.

The imports are given in the following table ; no export of flagstones, as such, are reported :—

STRUCTURAL MATERIALS.

TABLE 8.

IMPORTS OF FLAGSTONES.

| Fiscal Year. | Tons. | Value. |
|---|---|---|
| 1881............ | 23 | $ 241 |
| 1882............ | 90 | 848 |
| 1883............ | 10 | 99 |
| 1884............ | 137 | 1,158 |
| 1885............ | 205 | 1,756 |
| 1886............ | 1,602 | 9,443 |
| 1887............ | 1,316 | 10,966 |
| 1888............ | 2,642 | 21,077 |
| 1889............ | 1,669 | 15,451 |
| 1890............ | 5,665 | 48,995 |

Cement.

*Cement.*—There were during 1890 seven makers producing natural cement, as follows :—

| | |
|---|---|
| T. A. Gauvreau & Co.......................... | Quebec, Que. |
| C. B. Wright & Co.................................... | Hull do |
| Napanee Cement Works Co......... | Napanee Mills, Ont. |
| Jas. Marshall .................. .................... | Rymal do |
| Toronto Lime Co........ ... ............ | Limehouse do |
| John Battle ............................................. | Thorold do |
| Isaac Usher & Sons.............. ............ | do do |

These makers all produce a *natural* cement made from rock obtained in the immediate vicinity of their works. One company, The Imperial Portland Cement Co. (Ltd.), produce Portland cement only, and have their works at Pointe Claire, near Montreal, Another company, The English Portland Cement Co. (Ltd.), had under construction an extensive plant for the manufacture of Portland cement at Marlbank, Ontario, where they will during 1891 commence producing on a large scale, marl obtained in the neighbourhood entering largely into the manufacture.

Method of manufacture.

The method employed in the manufacture of *natural* cement is simple, and consists in the calcination of the raw stone or so-called "cement rock," after which it is ground by means of ordinary buhrstones. Before grinding, however, it is generally necessary that it should be broken into comparatively small lumps, which is accomplished by means of an ordinary cracker or crusher. The rock that produces a good natural cement consists essentially of an impure limestone or rather a carbonate of lime and magnesia with a definite proportion of silicate of alumina or clay and it is upon the amount of silica the rock contains that the quality of the finished product depends.

**Production.**

quantity of cement produced during 1890 was, according to returns :d at this office, 102,216 brls., valued at $92,405, showing an increase ıat reported for 1889 of 11,742 brls. and $22,615. The producr the past three years was as follows:—

1887—69,843 brls...........................................$81,909
1888—50,668 do ....................................... 35,593
1889—90,474 do ....................................... 69,790

**Imports.**

greater part of this production finds a market in Canada, as may ı on reference to the table of exports of lime and cement, wherein ıount of cement is known to be inconsiderable. The increase in :tion since 1888 is understood to be on account of the wider use ıolithic pavements and roadways.

imports of cement are given in the following tables:—

STRUCTURAL MATERIALS.

TABLE 9.

IMPORTS OF CEMENT IN BULK OR BAGS.

| Fiscal Year. | Bushels. | Value. |
|---|---|---|
| 1880 | 65 | $ 28 |
| 1881 | 579 | 298 |
| 1882 | 386 | 86 |
| 1883 | 1,759 | 548 |
| 1884 | 4,626 | 1,236 |
| 1885 | 4,598 | 1,315 |
| 1886 | 6,808 | 1,851 |
| 1887 | 5,421 | 1,419 |
| 1888 | 23,919 | 5,787 |
| 1889 | 32,818 | 10,668 |
| 1890 | 21,055 | 5,443 |

STRUCTURAL MATERIALS.

TABLE NO. 10.

IMPORTS OF HYDRAULIC CEMENT.

| Fiscal Year. | Barrels. | Value. |
|---|---|---|
| 1880 | 10,034 | $ 10,306 |
| 1881 | 7,812 | 7,821 |
| 1882 | 11,945 | 13,410 |
| 1883 | 11,659 | 13,755 |
| 1884 | 8,606 | 9,514 |
| 1885 | 5,613 | 5,396 |
| 1886 | 6,164 | 6,028 |
| 1887 | 6,160 | 8,784 |
| 1888 | 5,636 | 7,522 |
| 1889 | 5,835 | 7,467 |
| 1890 | 5,440 | 9,048 |

Portland cement.

### STRUCTURAL MATERIALS.

TABLE 11.

IMPORTS OF PORTLAND CEMENT.

| Fiscal Year. | Barrels. | Value. |
|---|---|---|
| 1880 .......... | .......... | $ 55,774 |
| 1881 .......... | .......... | 45,646 |
| 1882 .......... | .......... | 66,579 |
| 1883 .......... | .......... | 102,537 |
| 1884 .......... | .......... | 102,857 |
| 1885 .......... | .......... | 111,521 |
| 1886 .......... | .......... | 120,398 |
| 1887 .......... | 102,750 | 148,054 |
| 1888 .......... | 122,402 | 177,158 |
| 1889 .......... | 122,273 | 179,406 |
| 1890 .......... | 192,322 | 313,572 |

Assuming that the imports for the fiscal year represent those for the calendar year, there was, during 1890, a market for cement in Canada amounting to over $400,000.

Roofing cement.

*Roofing Cement.*—There was during the year a production of cement for roofing purposes of 1,171 tons, valued at $6,502. This is altogether the result of the manufacture of certain refractory minerals mined in Ontario.

Lime.

*Lime.*—Although the quantity produced is less than that made in 1889 there is a marked increase in total value, attributable almost entirely to the province of Ontario, where the prices ruled higher than during the year previous. In New Brunswick there is an apparent falling off in production of about 19 per cent, due no doubt to the introduction of the McKinley Bill, as the greater part of the production of that province finds a market in Boston and the New England states where it commands a good price on account of its superior quality.

There is nothing worthy of mention regarding the industry during 1890, the production as previously being that of works scattered throughout the various provinces and territories.

Production.

The amount produced during the year was, according to returns made to this office, 2,501,079 bushels, valued at $412,308, a decrease in quantity compared with 1889 of 447,170 bushels, whereas there is shown to be an increase in value of $49,460.

oduction by provinces, as well as the totals for the past four e given below:—

STRUCTURAL MATERIALS.
TABLE 12.
PRODUCTION OF LIME.

| Province. | No. of Returns | Bushels. | Value. |
|---|---|---|---|
| Ontario | 60 | 1,234,975 | $ 185,602 |
| Quebec | 15 | 116,593 | 23,274 |
| Nova Scotia | ...... | 217,944 | 44,565 |
| New Brunswick | 11 | 814,662 | 136,586 |
| Prince Edward Island | 3 | 17,355 | 3,581 |
| Manitoba | 3 | 69,550 | 10,700 |
| British Columbia | 1 | 30,000 | 8,000 |
| Totals | 93 | 2,501,079 | $ 412,308 |

STRUCTURAL MATERIALS.
TABLE 13.
ANNUAL PRODUCTION OF LIME.

| Year. | No. of Returns | Bushels. | Value. |
|---|---|---|---|
| 1886 | 87 | 1,535,950 | $ 283,755 |
| 1887 | 133 | 2,269,087 | 394,859 |
| 1888 | 93 | 2,216,764 | 339,951 |
| 1889 | 106 | 2,948,249 | 362,848 |

ıta cannot of course be obtained, though all the principal makers le returns, and it is supposed that the production shown above lent to about four-fifths of the total amount, the returns not being principally those of farmers and small local producers. following tables may be found the exports of lime and cement rts of lime:—

Exports and imports.

STRUCTURAL MATERIALS.
TABLE 14.
EXPORTS OF LIME AND CEMENT.

| Province. | 1887. | 1888. | 1889. | 1890. |
|---|---|---|---|---|
| | $4,269 | $12,262 | $12,877 | $17,341 |
| | 83 | 398 | 71 | ...... |
| ia | 142 | 278 | 11,017 | 17,137 |
| swick | 77,518 | 97,318 | 135,222 | 130,180 |
| ward Island | 4 | ...... | 2 | 5 |
| | 241 | ...... | ...... | ...... |
| | | | 2,060 | |
| lumbia | 4 | ...... | ...... | 4,141 |
| ls | $82,261 | $110,256 | $161,249 | $168,804 |

STRUCTURAL MATERIALS.

TABLE 15.

IMPORTS OF LIME.

| Fiscal Year. | Barrels. | Value. |
|---|---|---|
| 1880 | 6,100 | $6,013 |
| 1881 | 5,796 | 4,177 |
| 1882 | 5,064 | 5,365 |
| 1883 | 7,623 | 9,224 |
| 1884 | 10,804 | 11,200 |
| 1885 | 12,072 | 11,503 |
| 1886 | 11,021 | 9,347 |
| 1887 | 10,835 | 8,524 |
| 1888 | 10,142 | 7,537 |
| 1889 | 13,079 | 9,363 |
| 1890 | 8,149 | 5,360 |

Bricks.

*Bricks.*—There is very little to report in this industry during 1890, the production and distribution of operators being about the same as in past years. A feature worthy of mention is the fact that there are much larger quantities of pressed and fancy bricks made than heretofore, such works as those in the vicinity of Milton, Ont., and Ormstown, Que., turning out large quantities of fancy and more particularly pressed fancy bricks.

Production.

The production according to returns received at this office amounted during 1890 to 211,727 thousands, valued at $1,266,982. These returns are not considered complete, but are supposed to represent about four-fifths of the total, thus making the actual production about 260,000 thousand. The production by provinces is as follows:—

STRUCTURAL MATERIALS.

TABLE 16.

PRODUCTION OF BRICKS DURING 1890.

| Province. | No. of Returns. | Thousands. | Value. |
|---|---|---|---|
| Ontario | 221 | 138,491 | $807,389 |
| Quebec | 27 | 44,331 | 238,572 |
| Nova Scotia |  | 8,400 | 55,360 |
| New Brunswick | 10 | 9,335 | 68,885 |
| Prince Edward Island | 5 | 1,150 | 8,775 |
| Manitoba | 2 | 1,200 | 10,800 |
| North-West Territories | 3 | 900 | 10,000 |
| British Columbia | 9 | 7,920 | 67,201 |
| Totals | 277 | 211,727 | $1,266,982 |

total production per annum for the previous four years as ned to this office is as follows:—

| | | | |
|---|---|---|---|
| 1886—139,345 | thousand, valued | at | $ 873,600 |
| 1887—181,581 | do | do | 986,689 |
| 1888—165,818 | do | do | 1,036,746 |
| 1889—200,561 | do | do | 1,273,884 |

se figures may be taken as are those for 1890, as representing four-fifths of the total output.

Exports and imports.

mall quantity of bricks were exported during the year, principally Ontario, as may be seen on reference to the following figures:—

| | | |
|---|---|---|
| Ontario | 715 M | $3,449 |
| Nova Scotia | 19 M | 156 |
| Prince Edward Island | 15 M | 157 |
| Total | 749 M | $3,762 |

the imports (table 17) a great proportion is of fancy bricks ted into Ontario from Ohio, Pennsylvania and New Jersey. That mount is small is attributed to the fact that the market for them gely supplied by domestic manufacturers:—

STRUCTURAL MATERIALS.

TABLE 17.

IMPORTS OF BUILDING BRICK.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $ 2,067 |
| 1881 | 4,281 |
| 1882 | 24,572 |
| 1883 | 14,234 |
| 1884 | 20,258 |
| 1885 | 14,632 |
| 1886 | 5,929 |
| 1887 | 2,440 |
| 1888 | 20,720 |
| 1889 | 24,585 |
| 1890 | 12,500 |

Terra-Cotta.

*ra-Cotta.*—The terra-cotta industry, although comparatively new nada, has sprung into a state of no insignificance, the production e year 1890 amounting to about $90,000.

producers operating during the year were:—

Hynes Terra-cotta and Brick Company, Toronto, Ont.

Ontario Terra-cotta Brick and Sewer Company, Toronto, Ont.

Toronto Pressed Brick and Terra-cotta Company, Toronto, Ont.

The Rathbun Company, Deseronto, Ont.

The Ormstown Brick and Terra-cotta Company, Ormstown, Que.

The works of the Hyne's Terra-cotta and Brick Company are in Toronto. Those of the Toronto and Ontario Companies between Milton and Campbellville, Ont., while the two last company's works are at Deseronto, Ont., and Ormstown, Que., respectively. Besides producing a considerable quantity of pressed fancy bricks, these companies (with the exception of the Rathbun Company) produce large quantities of ornamental terra-cotta work, such as tiles, panels, string courses, roofing and ridge tiles, finials, chimney pots and garden vases and pedestals. Clay, eminently suitable for the manufacture of terra-cotta, occurs in many parts of the Dominion, though more especially in the Province of Ontario. Throughout the area underlain by the Medina and Clinton formations, this is particularly so, as the shales of these formations on decomposing, afford a good clay, containing a sufficient amount of iron oxide for colouring. The more important localities are of course those at present being operated, viz.:—Streetsville, Campbellville, Milton and Napanee Mills. Other localities are Freeman and Hamilton, in Wentworth county, and Limehouse, in Halton county.

Porous terra cotta.

At Deseronto the Rathbun Company are making a terra-cotta suitable for the fire-proofing of buildings. This material is made from a mixture of clay and sawdust in about equal proportions, when on firing in kilns the sawdust is burnt out, leaving a vesicular product known to the trade as "porous terra-cotta."

An experiment was made in the presence of the writer, where, in a small building 6x6x10 feet, built of 1-inch lumber and lined with 1½ inch terra-cotta furring, about one quarter of a cord of slabs and edgings, thoroughly saturated with kerosene, was ignited and allowed to burn for half an hour. Notwithstanding the intense heat in the interior, the sides and ends of the building were practically cool, while the roof (a flat one) was only warm. The fire was, at the end of half an hour, extinguished quickly with water, after which the walls were intact and had apparently suffered no injury. This company also manufacture porous terra-cotta in shapes suitable for the protection of wooden and iron beams and joists, as well as for arches for flooring, which have the advantage that, besides their fire-proof qualities, they add very materially to the strength of the flooring.

Test made at Toronto.

The following extract from the Toronto *Globe* of the 20th of May, 1890, gives an account of a test made at the Board of Trade building at that time in course of construction in Toronto :—

" An interesting test was made at the new Board of Trade buildings yesterday and is still in progress. The Rathbun Company, of Desento, manufacturers of terra-cotta fire proof flooring, made a test in the esence of Mr. E. A. Kent, Buffalo, architect of the building; Mr. W. iillips, superintendent of the works; Mr. Wills, secretary; Mr. J. I. ıvidson, president of the Board of Trade; and Mr. E. D. Morris, repre- nting the Rathbun Company. An arch which was thought to be fective was selected for the test. The arch, composed only of terra- tta fire proof, is held between iron beams. A slab of iron about a foot uare was placed in the centre of the arch, the span being 4 feet x 3 et. Over 5,000 lbs. of iron was piled on the piece of iron. More iron as piled on the arch in the afternoon, so as to ascertain the breaking eight of the arch. It finally broke under a pressure of 6,981 pounds, 5,800 pounds to the square foot."

In commenting on this account of the test the Rathbun Company ake the following remarks:—

"The test was made on the level floor of arch (no concrete) and com- enced at 11 a.m. when 5,800 lbs. was placed on the arch; the weight as left in position until 4:15 in the afternoon when 1,181 lbs. were lded, making in all 6,981 lbs., the last 116 lbs. causing the breakage.

"This test proves that the arch withstood 6,865 lbs. on 1 foot by 1 foot inches superficial area, or 5,721 lbs. to the square foot, the material ing 8 inches thick in hollow blocks forming a flat arch."

No statistics regarding terra-cotta are available beyond those of pro- ıction already given, nor is it possible to give figures of production for evious years.

Drain tiles

*Drain Tiles.*—The manufacture of ordinary drain tiles is carried on at any of the brick yards throughout the Dominion, though there are any yards which produce tiles alone. The state of the industry is very milar to that of the year previous, no new features having been veloped.

Production.

According to returns made direct to this office, and supposed to repre- nt about two-thirds of the total output, the production for the year 90 was 10,521 thousands, valued at $140,877, which, compared with 89, shows a decrease in quantity of 5 thousands and an increase in lue of $6,612. The production by provinces is shown as follows:—

### STRUCTURAL MATERIALS.

### TABLE 18.

### PRODUCTION OF TILES DURING 1890.

| Province. | No. of Returns. | Thousands. | Value. |
|---|---|---|---|
| Ontario | 84 | 10,372 | $138,647 |
| Quebec | 1 | 35 | 525 |
| Nova Scotia | | 11 | 160 |
| New Brunswick | 2 | 103 | 1,545 |
| Totals | 87 | 10,521 | $140,877 |

Returns of the production of tiles have been published by this office for the past four years, as follows :—

| | | | |
|---|---|---|---|
| 1886 | 12,416 M | valued at | $142,617 |
| 1887 | 14,658 M | do | 230,068 |
| 1888 | 7,518 M | do | 114,057 |
| 1889 | 10,526 M | do | 134,265 |

The imports are included with those of sewer pipes in table 19. No exports are reported.

Sewer pipes. *Sewer Pipes.*—During 1890 there were produced $348,000 worth of sewer pipes, which were made altogether from domestic clay and salt glazed. Statistics of imports only are available, and it is presumed that there were no exports. The following table shows the imports of sewer pipes and drain tiles :—

Imports.

### STRUCTURAL MATERIALS.

### TABLE 19.

### IMPORTS OF DRAIN TILES AND SEWER PIPES.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $ 33,796 |
| 1881 | 37,368 |
| 1882 | 70,065 |
| 1883 | 70,699 |
| 1884 | 71,755 |
| 1885 | 69,589 |
| 1886 | 57,953 |
| 1887 | 71,203 |
| 1888 | 101,257 |
| 1889 | 83,215 |
| 1890 | 77,434 |

Pottery.

*Pottery.*—Returns were received from 21 producers of pottery, aggregating $195,242. This amount is supposed to represent about four-fifths of the total output, as returns were not received from several operators known to have been producing during the year. The articles principally manufactured are flower pots, chimney pots, jars, crocks and all varieties of Rockingham and cane ware and earthenware. As may be seen on reference to the following table the production is largely that of the province of Quebec, where the larger and more important potteries are situated.

| | |
|---|---|
| Ontario | $ 76,242 |
| Quebec | 106,500 |
| Nova Scotia | 5,000 |
| Prince Edward Island | 3,000 |
| Manitoba | 4,500 |

Earthenware imports.

The following table shows the imports during the past eleven years, of which the greater part is made up of stoneware demijohns and jugs, Rockingham and other heavy stoneware:—

STRUCTURAL MATERIALS.

TABLE 20.

IMPORTS OF EARTHENWARE.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $322,333 |
| 1881 | 439,029 |
| 1882 | 646,734 |
| 1883 | 657,886 |
| 1884 | 544,586 |
| 1885 | 511,853 |
| 1886 | 599,269 |
| 1887 | 750,691 |
| 1888 | 697,082 |
| 1889 | 697,949 |
| 1890 | 695,206 |

Sands and gravels.

*Sands and Gravels.*—No returns of production of sands and gravels ave been received nor asked for, as it would be impossible to arrive, ven approximately, at the amount produced. The following table, owever, represents the amounts exported during the past two years by rovinces:—

### STRUCTURAL MATERIALS.

### TABLE 21.

### EXPORTS OF SAND AND GRAVEL.

| Province. | 1889. | | 1890. | |
|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. |
| Ontario | 282,774 | $51,830 | 341,656 | $64,398 |
| Nova Scotia | 172 | 690 | 170 | 750 |
| New Brunswick | 80 | 80 | 210 | 290 |
| Manitoba | ........ | ........ | 122 | 80 |
| British Columbia | 18 | 47 | ........ | ........ |
| Totals | 283,044 | $52,647 | 342,158 | $65,518 |

**The exports for the past fourteen years are as follows :—**

### STRUCTURAL MATERIALS.

### TABLE 22.

### EXPORTS OF SAND AND GRAVEL.

| Year. | Tons. | Value. | Year. | Tons. | Value. |
|---|---|---|---|---|---|
| 1877 | 11,998 | $ 2,151 | 1884 | 73,741 | $19,978 |
| 1878 | 50,140 | 8,381 | 1885 | 110,661 | 22,878 |
| 1879 | 46,999 | 9,438 | 1886 | 124,865 | 24,226 |
| 1880 | 53,951 | 11,177 | 1887 | 180,860 | 30,307 |
| 1881 | 58,693 | 15,129 | 1888 | 260,929 | 38,398 |
| 1882 | 60,158 | 16,218 | 1889 | 283,044 | 52,647 |
| 1883 | 55,346 | 14,065 | 1890 | 342,158 | 65,518 |

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GEOLOGICAL SURVEY OF CANADA
ALFRED R. C. SELWYN, C.M.G., LL.D., F.R.S., DIRECTOR

DIVISION OF

# MINERAL STATISTICS AND MINES

## ANNUAL REPORT

FOR

1891

ELFRIC DREW INGALL
*Associate of the Royal School of Mines, England,*
*Mining Engineer to the Geological Survey of Canada*
*In charge*

H. P. H. BRUMELL, F.G.S.A.
*Assistant to the Division*

OTTAWA
PRINTED BY S. E. DAWSON, PRINTER TO THE QUEEN'S MOST
EXCELLENT MAJESTY
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# NOTE

Except for the figures of imports, which refer to the fiscal year, beginning 1st July, the year used throughout this report is the calendar year, and the ton, that of 2,000 pounds, unless otherwise stated.

The figures given throughout the report referring to exports and imports are compiled from data obtained from the books of the Customs Department, and will occasionally show discrepancies, which, however, there are no means of correcting.

The exports and imports, under the heading of each province, do not necessarily represent the production and consumption of the province, *e. g.*, material produced in Ontario is often shipped from Montreal and entered there for export, so falling under the heading, Quebec.

The values of the metallic minerals produced, as per returns to this Department, are calculated on the basis of their metallic contents at the average market price of the metal for 1891. Spot values have been adopted for the figures of production of the non-metallic minerals.

N.E.S. = Not elsewhere specified.

To Dr. A. R. C. SELWYN, C.M.G., F.R.S., &c.,
Director and Deputy Head,
Geological Survey Department.

SIR,—I beg herewith to hand you the report of this Division on Mining and Mineral Production throughout the Dominion during 1891.

As in past years, it will be found to represent as complete a review of the mineral activities of the country and of their commercial results as it is possible to obtain with the means at command. These include the personal investigations of the officers of the Division, supplemented by the issue of circulars asking the production direct from the operators themselves, as well as information selected from official provincial reports and various other sources.

The labour of collecting, comparing and collating this very varied material so as to ensure accurate results and secure a complete and uniform presentment of them is very great, but it is hoped that the result will prove satisfactory.

As in the past, care is still taken to avoid injury to private interests in the manner of publishing results. The confidence of the mining community thus gained has resulted in an increasingly hearty response to our circulars, although, to complete our data, personal application is yet necessitated with a small number of people.

My own absence on sick leave and other exceptional causes explain the unusual delay in the presentation of this report, which it is hoped will not recur, whilst a yet more prompt response on the part of all applied to will help still further towards an earlier publication of the material.

Apart from the preparation of the annual report, the other functions of the Division have been performed as heretofore.

Numerous inquiries have been received and answered respecting the mining and mineral resources of the country, often involving considerable research to give the details asked for.

The preliminary summary of the mineral production in 1891, was issued the end of April, 1892, a revision of which will be found in the folder following p. 4 ss.

The reproduction herewith of the revised general summary stat ments for past years in tabular form speaks for itself.

During the summer season the field-work of the officers of the Div sion was as follows :—The writer was engaged in the study of a numb of points in the phosphate districts of Ottawa county, Que., relating t the nature and mode of occurrence of the deposits of that mineral begun in previous years. This investigation was incomplete when th new duties of my present office were undertaken. Mr. Brumell visite the various mining districts throughout New Brunswick and Ontari to collect information regarding the results of discovery and develop ment work there. Mr. Jas. White continued the mining surveys i the phosphate, mica and iron district traversed by the Kingston an Pembroke Railway.

It is desired to gratefully acknowledge the aid received from various sources. Thanks are due to those who, although too numerous to specify here, have, by answering our circulars or letters, provided much valuable material for the compilation of this report. Thanks are also due for aid received from the field officers of the Survey in making inquiries for us. Special mention must be made of the services rendered by my colleague, Mr. H. P. Brumell, assistant to the division, for his very important and efficient aid in every branch of the work. He has further contributed a separate report on Natural Gas and Petroleum (vol. V., part Q.) which will be a valuable addition to our knowledge of these mineral resources in Canada.

Our acknowledgments are also due the Provincial Departments of Mines of Nova Scotia and British Columbia and to the Dominion Customs Department for aid received.

I have the honour to be, sir,
Your obedient servant,
ELFRIC DREW INGALL.

Division of Mineral Statistics and Mines,
4th May, 1893.

## 86 to 1891.

| 1890. |  | 1891. |  | PRODUCT. |
|---|---|---|---|---|
| . | Value. | Quantity. | Value. |  |
| 1 | $902,050 | 8,928,921 | $1,160,760 | Copper. |
| 5 | 1,149,776 | 51,303 | 930,614 | Gold. |
| 1 | 155,380 | 68,979 | 142,005 | Iron Ore. |
| . | .............. | .............. | .............. | Iron Ore, Chromic |
| ) | 5,085 | 588,665 | 25.607 | Lead. |
| 2 | 933,232 | 4,626,627 | 2,775,976 | Nickel. |
| ... | 4,500 | .......... | 10,000 | Platinum. |
| 7 | 420,662 | 414,523 | 406,233 | Silver. |
| ... | $3,570,685 | .............. | $5,451,195 |  |
|  | (*a*) |  | (*a*) |  |
| 6 | $ 625 | 10 | $ 60 | Antimony-ore. |
| 5 | 1,500 | 20 | 1,000 | Arsenic. |
| 0 | 1,260,240 | 9,279 | 999,878 | Asbestus. |
| 1 | 6,496,110 | 3,623,076 | 8,144,247 | Coal. |
| 0 | 166,298 | 57,084 | 175,592 | Coke. |
| 0 | 3,500 | 685 | 3,425 | Felspar. |
| .. | .... (*b*) .... | 250 | 750 | Fire Clay. |
| 5 | 5,200 | 260 | 1,560 | Graphite. |
| 4 | 42,340 | 4,479 | 42,587 | Grindstones. |
| 9 | 194,033 | 203,605 | 206,251 | Gypsum. |
| 8 | 18,361 | 11,376 | 11,547 | Limestone (flux). |
| 8 | 32,550 | 255 | 6,694 | Manganese ore. |
| 9 | 68,074 | .......... | 71,510 | Mica. |

### EXPORTS.

Exports.

### LS AND MINERAL PRODUCTS MINED OR MANUFACTURED IN CANADA DURING 1891.

| oduct. | Value. | Product. | Value. |
|---|---|---|---|
| first class | $ 338,072 | Oil, refined | $ 104 |
| second class | 209,833 | Ore, antimony | 60 |
| third class | 13,636 | " iron | 11,573 |
|  | 1,163 | " lead | 5,000 |
|  | 2,881 | " manganese | 6,694 |
| ufactures of | 158 | " silver | 225,312 |
|  | 3,393,773 | Phosphate | 384,661 |
|  | 348,109 | Plumbago, crude | 72 |
|  | 344,692 | " manufactured | 163 |
| es | 28,433 | Salt | 1,277 |
| crude | 181,795 | Sand and gravel | 59,501 |
| ground | 588 | Slate | 195 |
| teel, about | 300,000 | Stone, unwrought | 46,162 |
|  | 119,853 | " wrought | 13,398 |
| le and cut. | 35,252 | Other articles | 12,194 |
| nd | 2,338 |  |  |
|  | 667,280 | Total | $6,772,693 |
|  | 18,471 |  |  |

### EXPORTS

### UCTS OF THE MINE, WITH DESTINATIONS, DURING FISCAL YEAR 1891.

| orted to. | Value. | Exported to. | Value. |
|---|---|---|---|
| ates | $4,600.800 | Spanish West Indies | $ 11,454 |
| ain. | 851,794 | Hong Kong | 9,640 |
| land | 141,692 | Australia | 8,418 |
| Islands | 49,064 | British Guiana | 5,114 |
|  | 31,217 | Japan | 4,664 |
|  | 22,774 | China | 150 |
|  | 16,188 |  |  |
| est Indies | 16,023 | Total | $5,784,143 |
|  | 15,151 |  |  |

Imports.

## IMPORTS.

### MINERALS AND MINERAL PRODUCTS FOR FISCAL YEAR 1891.

| Product. | Value. | Product. | Value. |
|---|---|---|---|
| Alum and aluminous cake.. | $ 22,411 | Iron and steel... . .... | $ 10,354,073 |
| Antimony.... ........ | 17,483 | Lead and manufactures of. | 315,146 |
| Arsenic.... ........... | 4,027 | Lime. ................ | 4,273 |
| Asbestus and mfrs. of..... | 13,298 | Litharge.. ............. | 27,613 |
| Ashes, pot, pearl and soda. | 2,757 | Lithographic stone........ | 5,724 |
| Asphaltum. .. ........ | 50,728 | Manganese, oxide of . . . | 3,743 |
| Borax .. . . ....... | 22,602 | Marble...... ........... | 107,661 |
| Brass and manufactures of. | 603,078 | Mercury...... ......... | 20,223 |
| Bricks ............... .. | 9,744 | Mineral water............ | 41,797 |
| " bath.............. | 2,299 | Nickel....... ......... | 62 |
| " and tiles, fire...... | 116,390 | Ochres................... | 20,550 |
| Buhrstones. .. ........ | 2,089 | Paraffine wax............ | 52,391 |
| Building stone... . .. .. | 170,890 | Petroleum and mfrs. of.... | 513,966 |
| Cement.. .. ........... | 9,061 | Plaster of Paris ........ | 8,412 |
| " Portland......... | 304,648 | Platinum.. .. .......... | 4,055 |
| Chalk.......... ........ | 8,193 | Potash salts.. .......... | 10,185 |
| Clay, china.............. | 24,429 | Precious stones...... ... | 77,988 |
| " fire .. ......... | 24,878 | Salt .... .......... .... | 380,550 |
| " all other, N.E.S... | 6,827 | Sand and gravel... . .... | 23,620 |
| Coal, anthracite.... .... | 5,224,452 | Silex ..... ........... | 1,929 |
| " bituminous.... .... | 4,060,896 | Slate .. . ......... | 46,104 |
| " dust, &c . ........ | 36,130 | Soda salts.. ... ... ...... | 402,332 |
| " tar and pitch....... | 35,721 | Stone and granite, N.E.S.. | 61,051 |
| Coke.................... | 179,539 | Spelter.................. | 31,459 |
| Copper and mfrs. of.. ... | 573,974 | Sulphate of copper........ | 43,614 |
| Copperas.. ............ | 6,310 | Sulphur.......... ...... | 46,351 |
| Earthenware............. | 634,907 | Sulphuric acid........... | 2,466 |
| Emery and pumice... ... | 19,875 | Tiles, sewer pipes, &c..... | 87,195 |
| Fertilizers..... ......... | 45,375 | Tin and manufactures of.. | 1,206,918 |
| Flagstones.............. | 36,348 | Whiting................. | 27,504 |
| Fuller's earth............ | 4,511 | Yellow metal............ | 125,605 |
| Glass and glassware....... | 1,247,692 | Zinc and manufactures of.. | 112,201 |
| Graphite and mfrs. of..... | 41,710 | | |
| Grindstones.......... .... | 16,991 | Total........... .. | 27,747,879 |
| Gypsum................ | 855 | | |

ABRASIVE MATERIALS.

## ABRASIVE MATERIALS.

There is nothing new to add to what was said in last year's report on this subject. The only production coming under this head of which any figures are available is that mentioned as under, relating to grindstones.

Grindstones.

*Grindstones.*—The total production of this commodity for the year was as follows:—

| | | |
|---|---|---|
| New Brunswick........ | 2,499 tons, | valued at $22,787 |
| Nova Scotia........... | 1,980 " | 19,800 |
| | 4,479 | $42,587 |

From New Brunswick returns are received direct from the producers, whilst the only figures furnished by the Provincial Department of Mines for Nova Scotia are those of exports.

As shown by the following figures the extent of this industry has remained practically constant for several years past:—

| | |
|---|---|
| 1886—4,000 tons, valued at | $46,545 |
| 1887—5,292 " | 64,008 |
| 1888—5,764 " | 51,129 |
| 1889—3,404 " | 30,863 |
| 1890—4,884 " | 42,340 |
| 1891—4,479 " | 42,587 |

As in former years, a number of operators with quarries situated in New Brunswick and Nova Scotia have contributed to the total production, those of the former province being chiefly situated in Westmoreland, Northumberland and Gloucester counties, and in the latter in Pictou and Cumberland counties.

Referring to his visit to the quarries at Rockport, N.B., during the course of his summer's field work Mr. Brumell furnishes the following notes:—

"Along the shores of Cumberland Basin at many places between Cape Maringouin and Wood Point large quantities of grindstones are made. The stone, which is gray in colour and very free from 'mud spots' or 'bulls,' is obtained under tide-water and floated into the shallower parts where it is 'scabbled' and shipped principally to Boston and points in the New England States. Only large stones are shipped, the average weight being about two tons."

Tripoli.

*Tripoli.*—Although deposits of infusorial earth of greater or less extent are plentiful in the bottoms of many lakes in Nova Scotia and New Brunswick there are no available records of production. It is known, however, that if any has been produced during the year the amount must be insignificant.

Pumice,
Emery,
Buhrstone.

*Pumice, Emery, Buhrstone.*—None of these materials have been mined in Canada during the year.

The subjoined tables of exports and imports of abrasive materials explain themselves.

ABRASIVE MATERIALS.

Exports and Imports.

## ABRASIVE MATERIALS.

### TABLE 1.

### EXPORTS OF GRINDSTONES.

| Year. | Value. |
|---|---|
| 1884 | $28,186 |
| 1885 | 22,606 |
| 1886 | 24,185 |
| 1887 | 28,769 |
| 1888 | 28,176 |
| 1889 | 29,982 |
| 1890 | 18,564 |
| 1891 | 28,433 |

## ABRASIVE MATERIALS.

### TABLE 2.

### EXPORTS OF GRINDSTONES.

| Provinces. | 1889. | 1890. | 1891. |
|---|---|---|---|
| Ontario | ........ | ........ | ........ |
| Quebec | $ 1,387 | $ 12 | ........ |
| Nova Scotia | 7,150 | 8,536 | $12,387 |
| New Brunswick | 21,437 | 10,016 | 16,046 |
| Manitoba | 8 | ........ | ........ |
| Totals | $29,982 | $18,564 | 28,433 |

## ABRASIVE MATERIALS.

### TABLE 3.

### IMPORTS OF GRINDSTONES.

| Fiscal Year. | Tons. | Value. |
|---|---|---|
| 1880 | 1,044 | $11,714 |
| 1881 | 1,359 | 16,895 |
| 1882 | 2,098 | 30,654 |
| 1883 | 2,108 | 31,456 |
| 1884 | 2,074 | 30,471 |
| 1885 | 1,148 | 16,065 |
| 1886 | 964 | 12,803 |
| 1887 | 1,309 | 14,815 |
| 1888 | 1,721 | 18,263 |
| 1889 | 2,116 | 25,564 |
| 1890 | 1,567 | 20,569 |
| 1891 | 1,381 | 16,991 |

ABRASIVE MATERIALS.

Imports.

### ABRASIVE MATERIALS.

### TABLE 4.

### IMPORTS OF "SILEX."*

| Fiscal Year. | Cwts. | Value. |
|---|---|---|
| 1880 | 5,252 | $2,290 |
| 1881 | 3,251 | 1,659 |
| 1882 | 3,283 | 1,678 |
| 1883 | 3,543 | 2,058 |
| 1884 | 3,259 | 1,709 |
| 1885 | 3,527 | 1,443 |
| 1886 | 2,520 | 1,313 |
| 1887 | 14,533 | 5,073 |
| 1888 | 4,808 | 2,385 |
| 1889 | 5,130 | 1,211 |
| 1890 | 1,768 | 2,617 |
| 1891 | 3,674 | 1,929 |

* The material thus classified by the Customs Department as "Silex" probably sents tripoli or manufactures of the same.

### ABRASIVE MATERIALS.

### TABLE 5.

### IMPORTS OF PUMICE STONE AND EMERY.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $ 7,854 |
| 1881 | 11,179 |
| 1882 | 15,762 |
| 1883 | 17,823 |
| 1884 | 16,518 |
| 1885 | 14,450 |
| 1886 | 14,458 |
| 1887 | 15,617 |
| 1888 | 18,564 |
| 1889 | 16,888 |
| 1890 | 19,925 |
| 1891 | 19,875 |

ABRASIVE MATERIALS.
Imports.

ABRASIVE MATERIALS.
TABLE 6.
IMPORTS OF BUHRSTONES.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $12,049 |
| 1881 | 6,637 |
| 1882 | 15,143 |
| 1883 | 13,242 |
| 1884 | 5,365 |
| 1885 | 4,517 |
| 1886 | 4,062 |
| 1887 | 3,545 |
| 1888 | 4,753 |
| 1889 | 5,465 |
| 1890 | 2,506 |
| 1891 | 2,089 |

ANTIMONY.

## ANTIMONY.

Production.

Small as has been the production of the ores of this metal in Canada of late years, the amount reported for this year is still less, viz., 10 tons, valued at $60.

The production since 1887 is as follows:—

| | | | |
|---|---|---|---|
| 1887 | 584 tons, | valued at | $10,860 |
| 1888 | 345 | " | 3,696 |
| 1889 | 55 | " | 1,100 |
| 1890 | 26½ | " | 625 |
| 1891 | 10 | " | 60 |

This is all the production of the province of Nova Scotia, the Department of Mines of which province furnishes the above data, but gives no further information, neither was it found possible for a visit to be made to the vicinity by any of our own officers.

The following table, No. 1, gives the exports of antimony ore:—

Exports.

ANTIMONY.
TABLE 1.
EXPORTS.

| Year. | Tons. | Value. | Year. | Tons. | Value. |
|---|---|---|---|---|---|
| 1880 | 40 | $ 1,948 | 1886 | 665 | $ 31,490 |
| 1881 | 34 | 3,308 | 1887 | 229 | 9,720 |
| 1882 | 323 | 11,673 | 1888 | 352½ | 6,894 |
| 1883 | 165 | 4,200 | 1889 | 30 | 695 |
| 1884 | 483 | 17,875 | 1890 | 38 | 1,000 |
| 1885 | 758 | 36,250 | 1891 | 3½ | 60 |

ANTIMONY.

The figures of imports as given in Table No. 2 will represent Canada's consumption of the metal, as no ores are imported.

ANTIMONY.

TABLE 2.

IMPORTS.

Imports.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880 | 42,247 | $ 5,903 |
| 1881 | ..... | 7,060 |
| 1882 | 183,597 | 15,044 |
| 1883 | 105,346 | 10,355 |
| 1884 | 445,600 | 15,564 |
| 1885 | 82,012 | 8,182 |
| 1886 | 89,787 | 6,951 |
| 1887 | 87,827 | 7,122 |
| 1888 | 120,125 | 12,242 |
| 1889 | 119,034 | 11,206 |
| 1890 | 117,066 | 17,439 |
| 1891 | 114,084 | 17,483 |

## ARSENIC.

ARSENIC.

Production.

In regard to this mineral product there is nothing different to report. The already small record of past years was slightly lowered again in 1891, to which year we can only credit 20 tons, valued at $1,000. These amounts as compared with former years are as follows:—

| | | | | | |
|---|---|---|---|---|---|
| 1885 | *440 | tons, | valued at | $17,600 | spot. |
| 1886 | 120 | " | " | 5,460 | do |
| 1887 | 30 | " | " | 1,200 | do |
| 1888 | 30 | " | " | 1,200 | do |
| 1889 | Nil | " | " | Nil | do |
| 1890 | 25 | " | " | 1,500 | do |
| 1891 | 20 | " | " | 1,000 | do |

As in previous years, the arsenious oxide above mentioned is manufactured by resubliming the crude arsenious oxide found in the condensation chambers of the mines which were working in 1885 on the arsenical gold ores of Deloro in the Madoc region of Ontario. Small quantities of this crude material, resulting from the roasting of these ores, have been refined from year to year to meet a limited demand. This work employed three men for two months.

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* Imports into United States from the Deloro mine, according to Report on the Mineral Resources of the United States, 1885.

ARSENIC.

Imports.

### ARSENIC.

### TABLE I.

### IMPORTS.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880 | 18,197 | $ 576 |
| 1881 | 31,417 | 1,070 |
| 1882 | 138,920 | 3,962 |
| 1883 | 51,953 | 1,812 |
| 1884 | 19,337 | 773 |
| 1885 | 49,080 | 1,566 |
| 1886 | 30,181 | 961 |
| 1887 | 32,436 | 1,116 |
| 1888 | 27,510 | 1,016 |
| 1889 | 69,269 | 2,434 |
| 1890 | 138,509 | 4,474 |
| 1891 | 115,248 | 4,027 |

ASBESTUS.

## ASBESTUS.*

Production.

During 1891 the production of asbestus fell off considerably as compared with the output of the year previous, that for 1891 being only 9,279 tons, valued at $999,878, against 9,860 tons, valued at $1,260,240, which was the quantity extracted in 1890. For past years reference must be made to the accompanying graphic table, wherein may be traced the growth of the industry from 1880, when but 380 tons were produced.

Of the total amount shipped from the mines the greater part was exported, largely to the United States, small quantities only going to the various European markets.

By the kind permission of the author, we have incorporated the following exhaustive paper, read on the 14th June, 1892, before the General Mining Association of Quebec by Mr. L. A. Klein, manager of the American Asbestus Co. at Black Lake, Que. :—

Present condition, etc., of the industry.

### THE CANADIAN ASBESTUS INDUSTRY.

*By L. A. Klein, M.E., Black Lake, Que.*

"The asbestus industry of Canada has assumed a rank which makes it well worth while to study how to further develop the same, and many have turned their eyes towards our province and its serpentine regions: Governments, capitalists, mining men, speculators, prospec-

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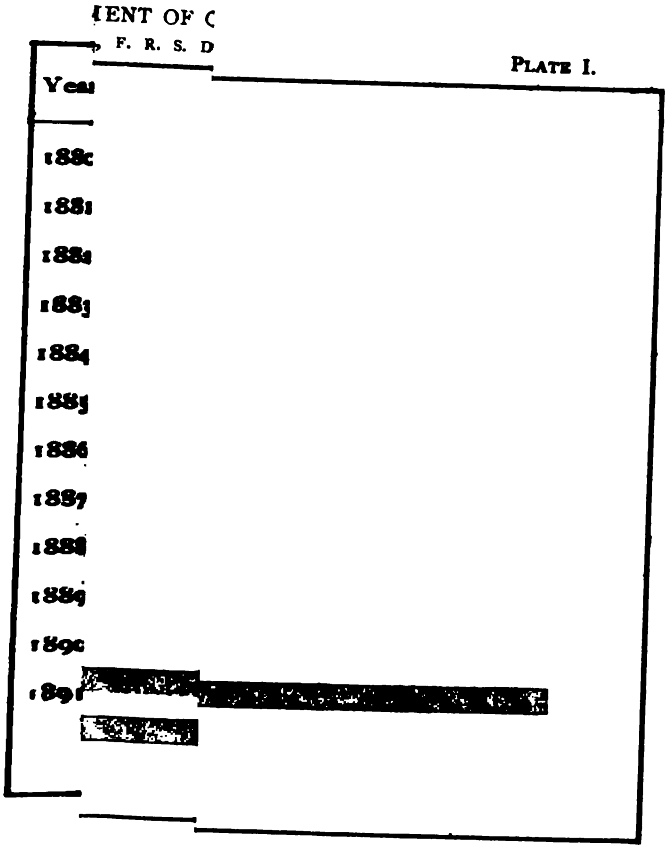
*See Foot note p. 14 SS.



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which have as yet received prominency and which practically supply the demand of the world. These are in the districts of Thetford and Black Lake, with some more or less encouraging developments to the

ARSENIC.

Imports.

## ARSENIC.

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ASBESTUS.

Production.

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*See Foot note p. 14 SS.

ASBESTUS.

Present condition, etc., of the industry.

"Many things have been said and written on asbestus, asbestus formation, asbestus industry, asbestus uses and markets, and it is certainly not the lack of talk on the subject which has induced me to take it up for this paper. I have been led to do so in consideration of the facts that by former writers on the subject a good many practical points have not been touched—points which must be of special interest to those who are about to interest themselves in the industry, be it with money, be it with actual work—but also in consideration of the fact that amongst those not intimately connected with the industry, opinions of an altogether erroneous nature as to the value and character of the industry are spread about, which may occasionally lead to a very inconvenient disappointment. There are even a good many things amongst us mining men out here on which the difference of opinion has not as yet reached a settlement, as it is naturally with an industry in such a young state as ours.

"I have tried to get the co-operation of all my fellow miners in the industry to make my statements as complete as possible, and I tender my heartiest thanks to those who have complied with my request. I must, however, add that the opinions expressed in this paper are individual, and under no other authority than that of my own observations and my own judgment.

"I had still another object in delivering this paper, and that is to show the asbestus industry in Canada from a national and economic point of view, or, in other words, to look at it as a whole, and a resource for our province and the Dominion of Canada respectively.

"You have to-day looked over the asbestus mines in Thetford and Black Lake, and, while the time was very limited and no chance whatever could be given to follow up a special line of the business in which we are engaged, you have, however, had an opportunity to see in general the mode of occurrence and production of asbestus. While you have done so you have seen the area which, I may safely say, produces about 85 per cent of all the asbestus used in the world.

Mode of occurrence.

"Serpentine covers quite a large area in Canada, and especially in the eastern townships of Quebec. It is not my object to-day to describe its extent, which has been done in an exhaustive way as well by members of the Geological Survey as by the authorities of our Provincial Government, but I will confine myself to those districts which have as yet received prominency and which practically supply the demand of the world. These are in the districts of Thetford and Black Lake, with some more or less encouraging developments to the

ASBESTUS.

Mode of occurrence.

north and south; the district of Danville, with, so far, one prominent mine in the production of asbestus; and the Templeton district, in which, however, the industry has not yet assumed more than an exploratory character.

"If you compare these very limited areas, representing the region of the big serpentine belt which produces asbestus in a quantity and quality which will, economically worked, yield a profit to the investor, with the comparatively enormous extent of serpentine rock, you will readily come to the conclusion that it takes more than the finding of the serpentine to have a paying asbestus mine, and that is one point I would like to pick out and submit to your consideration.

"While the undoubted success of some of the existing mines, in combination with erroneous ideas on the formation, occurrence and of production and so on, nursed by speculators, lead many to believe that they struck a fortune when a locality was shown to them which contained serpentine of a very good or just the right colour, with occasionally a small asbestus seam in it; and while many have been induced to spend a considerable amount of money under these false impressions, I may state that not one enterprise has proved successful in this industry which has not had anything else to look on than serpentine of a good colour. All those successful mines had as surface indications asbestus in good and large veins of real commercial value, and I do not hesitate to say in some cases larger veins than they can get to-day. We may be able to declare a locality worthless as an asbestus mine, judging from colour and sections of serpentine, but I am certain that neither I, nor any of my confrères who have devoted some of their time to the study of the subject, would commit ourselves in recommending a locality as an asbestus mine from the good look of the serpentine, without having seen besides really valuable and marketable asbestus veins in sufficient quantity, and this notwithstanding the expression of one of our scientific authorities that the rock likely to prove asbestus-producing can be determined by certain peculiarities of texture, colour or weathering.

Characteristics.

"I will not take up your time with a detailed description of the mineral, but merely make a very few general remarks.

"Asbestus is a fibrous variety of serpentine,* and is, chemically speaking, a hydrous silicate of magnesia. From several analyses of a number of specimens all over the world, which I had at my disposal, the percentage of silica is from a little over 40 to 40½ per cent, while

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* Whilst the term "asbestus" now includes commercially the fibrous variety of serpentine, chrysotile, which is the mineral mined in Quebec if applied primarily and still applies mineralogically only to the fibrous varieties of hornblende.

ASBESTUS.
Characteristics.

magnesia is from 41½ to 43 per cent; other more prominent admixtures were ferrous-oxide and alumina in quantities of from one to three per cent, and further, traces of lime, potash, soda, chlorine and sulphuric acid. This composition is completed by water, to which we have to attach the most importance from a business point of view. This, of course is not water in the form of a moisture, but water intimately" (chemically) "associated with the silicate of magnesia. The importance of this water has been shown by the fact that good and fine asbestus fibre, may it be from the Italian variety, or from the Cambrian rocks of the EasternTownships, or the Laurentians from the north of the St. Lawrence, contains from 13½ to 14 per cent of this water, while some very harsh and brittle specimens of asbestus have shown considerably below 12 per cent. Experiments have further shown that it is comparatively easy to dissociate a part of this water from a fine and silky specimen of asbestus fibre and to render the same hard and brittle by heating it to a certain extent. This peculiarity leaves us to conclude why we find such considerable differences in the qualities of asbestus in comparatively close proximity, as, for instance, the larger percentage of "thirds" in Black Lake than in Thetford; and then even at the best mines, qualities of no, or very little, commercial value. The asbestus in these localities has been rendered harder by the influence of heat through the intrusion of heated matter, following the original formation of it, and this heated matter has been the masses of granulite which we find throughout our serpentine region, with the exception of a small knoll of serpentine in Thetford, where granulite appears only in very small dykes. And here is another point where I differ from some of our fraternity who hold that the presence of these masses of granulite are a good indication of asbestus—a theory which I think can scarcely be maintained, at least, however, as to asbestus of commercial value, in the close neighbourhood of these masses of granulite.

Companies working.

"Thirteen incorporated companies with an authorized capital of about three and one-half million dollars, of which a part, however, is employed in the manufacturing business in England, with a number of very prominent private concerns, occupy themselves to-day with the production of asbestus and asbestus mining, and I believe that my estimate that about two and one-quarter millions of dollars are invested in the industry in Canada comes very close to the reality.

Mining.

"While until about four or five years ago, with one single exception, hand work, occasionally connected with horse power hoisting, was exclusively used in asbestus mining, the leading mines are now equipped with more or less extensive plants of machinery to carry on the work.

ASBESTUS. Mining.

"This work consists,

"Firstly—Of the proper mining operations, such as the drilling, blasting, removing of the broken rock out of the pits to the dumps, hand in hand with the gathering up of the asbestus veins and transport of same to the dressing establishments or cobbing sheds.

"Secondly—The dressing or cobbing, that is, the separating of the asbestus fibre from the adhering rock and the grading of the former in different qualities, followed by packing, transport to railroad, loading, shipping and marketing. It may not be unwise to review these different operations shortly, as the circumstances under which asbestus is produced are entirely different from nearly any other mineral or ore, and we find nearly every item which we were used to consider as a thoroughly established rule greatly changed by these circumstances.

"This is readier understood when we consider the large amount of rock which has to be handled in comparison to the ore, the peculiar nature of this rock, the character of the ore, which is a fine silky fibre, and must be carefully protected from injury, and so on.

"As to the drilling, hand drilling is still in exercise in all the newly opened mines for prospecting work, and even in one or the other of these mines which have already reached considerable prominency. It is further nearly exclusively used for block-holing—only very recently one of the mines has introduced a small size machine drill for the purpose. It is done by three men with 1 inch octagon steel, and 6 to 7 pound hammers. The average capacity is about 15 to 16 feet a day of 10 hours, and the cost about 20 cents per foot. The depth of holes is thus seldom exceeding 4 feet. Some of the mines have not long ago adopted a plan of block-holing with one man only, using a three-quarter inch steel, and 3 to 4 pounds short-handled hammer. The capacity is thus about 8 feet for 10 hours' work and the cost only about 14 cents.

"Most of the mines do their drilling, however, with steam or compressed air, 45 feet per day of 10 hours in the former case, and from 50 to 55 feet in the latter being considered a fair day's work. The expense per foot may be set, considering the present prices for fuel, at from 7 to 8 cents per foot, not including wear and tear on machinery and interest for capital involved in the buying of the necessary machinery. There are in all 7 compressors with a total of 44 drills capacity in use, four of them being built by the Rand Drill Company, two by the Ingersoll Rock Drill Company, and one by the Norwalk people. At present also, 44 steam" (machine) "drills are employed in the industry, of which, however, 11 are run by steam. About one-half of all drills in use are Rand's Little Giant No. 3, 3 Rand sluggers, 5 Ingersoll 3-inch, and 12 Sergeant's—a couple or so being of other manufacture. The steel in use is 1¼ octagon and costs in the neighbourhood of 10 cents a pound. As a rule the drills are worked under 80 pounds pressure to square inch. We may consider an expense of 3½ cents to the ton of broken rock as the average cost at present.

"The blasting is now generally done with dualin, which contains 35 per cent of nitro-glycerine, of which the cost is at present 20 cents per pound, but which prices will be very likely further reduced through the competition of a newly erected powder factory in the district. With all of the larger mines the blasting is done by electricity; still there are some which hold to the system of one hole blasts, claiming that by this system less of the asbestus veins are smashed to small particles and scattered all over the place, therefore involving more expense to pick them up. The expense for explosives is about 3 cents to the ton of rock broken.

"The next operation is the removing of the broken rock from the pits to the dumps with which the picking up of all the asbestus veins goes hand in hand. If the bottom of the pits are on the same level with the top of the dumps, the operation is simply to load the refuse rock on trucks, stone-boards, wheelbarrows, etc., and bring it by one or the other of these means to the dumps; where this is not the case, as in most of the more extensively worked mines, where pits vary in depth from about 30 to 150 feet, the rock has to be hoisted up by means of derricks. At the disposal of this industry there are at this time about 75 derricks, of which, in two cases hand, and in twelve or thirteen cases horse-power is applied as motor, the rest being steam derricks. Hand and horse derricks have of course only a right to exist where there is a comparatively small amount of rock to be handled and where the works are of a more or less exploring character only, and the first expenses of putting in steam plant seems unadvisable. The steam derricks are to be distinguished in two classes, boom and cable derricks; from the latter class only two being so far in use. Boom derricks consist of a mast held by means of guys in a vertical position and turnable on its own axle, while to the foot of the mast a boom or arm is attached and suspended in a more or less horizontal position by means of ropes stretching from end of mast to end of boom. The length of the latter is generally from 40 to 50 feet, and it is clear that the working space of such a boom is limited by its length and can, economically, hardly be extended to more than say 50 feet.

"The cable derricks have a mast somewhat similar to the former, but instead of a boom, a cable with a traveller on it, which cable is stretched from top of mast to some point across the pit, allowing by

ASBESTOS.
Mining.

means of the traveller, to hoist from any point of the cable. As this may be stretched to a length of 400 and more feet the enormous advantage over boom derricks seems clear, and I have no doubt that its general introduction is only a question of time. The ropes used for hoisting are $\frac{5}{8}$ to $\frac{3}{4}$ in. crucible cast steel, the guy ropes generally $\frac{7}{8}$ of an inch; the cables $1\frac{1}{2}$ or 2 in. steel ropes.

"There are 18 double and 24 single drum hoistings and winding engines employed in the industry, or a total of 60 drums. The so hoisted refuse rock is placed on lorries and wheeled out on the dumps either by hand, or, where the dumps are somewhat long, by horses, and there discharged. In some of the mines, to a great advantage, self-dumping cars of a very simple construction are being used. While now nearly all the larger mines use iron or steel rails, and lately, specially of the lighter sort (19 lbs. Canadian make, at a price of $40 per ton delivered) there are still some wooden rails with band iron top in use, which practice, however, with the growth of the industry, will have to be soon abandoned.

"The transport of the crude asbestus to the dressing or cobbing sheds is in most cases done by the simple means of a cart and a horse, or where sheds of a more or less provisional character are placed right on the edge of the pits, carried in by hand. Where the cobbing is more concentrated in a special and permanent establishment we find rail connection for the purpose. Two of the mines, however, have a more or less systematic handling of the stuff in this state—consisting of iron self-dumping skips, which are loaded directly from the pits. hence they proceed down an inclined railroad and discharge their loads directly in the cobbing establishment. The skips are brought back by means of winding engines. The cost of the above-described operations, viz., removing of refuse rock, hoisting, picking of asbestus and its transport to sheds, are of course somewhat influenced by the size of the veins in the respective bed rock, the heights and accessibility of the pit's face, lengths of dumps, and so on, but may with fair certainty be set at 22 cents per ton of rock handled in summer time, which figures unfortunately increase in winter time, in some cases to 35 cents, and may be accepted with 25 cents for all year round work.

Dressing.

"The second part of the operation at the asbestus mine is the dressing, or commonly called cobbing, which comprises the freeing of the asbestus veins from rock as much as possible (the crude asbestus in the market still contains from 15 to 40 per cent of rock, some manufacturers even claim more than that while they are negotiating new contracts), and the grading in two, three or four different grades. This operation is as a rule done by hand by little boys, with the aid of

ASBESTUS. Dressing.

a hammer weighing about 1½ lbs. Some of the mines, however, have partially or entirely adopted the aid of machinery, and this more particularly for the transformation of the so-called cobbing stones—*i.e.*, larger pieces of rock with a more or less valuable asbestus vein in it, a vein, however, which did not give away from the blast, and which requires the breaking away of the adhering rock by means of powerful blows (sledge hammers), or compression (crushers). The first to try and solve the problem was the Scottish Canadian Asbestus Co. Unfortunately the development of the process sustained a sudden interruption by the closing of the mines in the autumn of 1888. Their plant consists of a 50 horse-power engine, Blake rock breaker, travelling picking tables, set of Cornish rolls, revolving screens, elevators, shakers, two large blowers, and so forth. Next the American Asbestus Co. started in to experiment in the winter of 1890–91. The main object then was to do away with the somewhat indistinguishable grade of No. 2, an object, however, which was difficult to reach, unless the fibre could have been thoroughly loosened and freed from stone. Their plant consisted in the main of a Blake crusher, to which the crude asbestus is conveyed by an inclined railway, and automatically dumped in front of the crusher. The jaws of the crusher are set at 1½ inches, the crushed stuff drops on an inclined sieve in shaking motion, which separates all the loose fibre and the dust from the larger pieces of rock and asbestus veins, the former going directly to the cleaning or grading machines, the latter dropping on a revolving picking table, where the barren rock is removed by hand to one side of the table, the asbestus veins being left on the other. At the end of the table is a receiving chute which is divided into two compartments, and into which rock and asbestus are discharged respectively. The rock drops from the chute directly into a lorry and is wheeled to the dumps, while the asbestus is conveyed either to the dry kilns, as necessary in winter time or rainy weather, or to the fine crushers for further manipulation.. These latter are of unique construction, of which the object is to allow particles of a certain size and loosened fibre to go through, without being further crushed, as thereby the asbestus fibre is likely to be injured. This so reduced stuff is brought to the cleaning and grading machines, consisting mainly of a set of inclined sieves in rapid shaking motion in connection with blowers, fans, etc.—remaining unbroken stone and unloosened fibre going back to a set of still finer crushers to undergo the process again. The plant at King Bros.' mines in Thetford, which was principally erected for the extraction of asbestus out of large pieces of rocks on the old dumps works—which some years ago did not warrant the expenses for block-holing

ASBESTUS. Dressing.

and further handling—consists of a Blake crusher, from which the stuff is conveyed on a set of Cornish rolls with the intention of having all stone reduced to powder—from there to a revolving screen of which the object was to screen out all the dust and leave the clean fibre. This object, however, has not been fully realized, owing to the failure of the rolls to break up the rocks entirely, and an additional blowing and screening plant has been put in, which produces now a very clean product of one grade. The Anglo-Canadian also runs a crusher and a set of sieves, and the Johnson's Co. has recently put in a couple of crushers to overwork the old dumps. None of the processes at their present state, however, may as yet be considered complete, the main difficulties being two :—

" 1. That, if asbestus is crushed with a considerable amount of stone together until the latter is reduced to powder—the long and most valuable asbestus fibre is partially destroyed.

" 2. If the stone is not entirely reduced before grading it is nearly impossible to free the fibre from the stone, and a large amount of waste is the result.

" Besides, development of this part of the industry has to stand other very trying circumstances, as the objections of a good many of the manufacturers to buy prepared fibre; the trouble with the customs, which is rather inclined to classify the so prepared asbestus as manufactured, and to levy a duty of 25 per cent value on same, and the considerable amount of low grade waste which is found very hard to dispose of.

" The cost of cobbing varies, of course, considerably, according to the quality of material. While some stuff will break from the stone very easy, other requires considerable labour; then larger veins will sooner be gathered than small ones, and while some stuff occasionally may be contracted at $3 per ton (this, however, never includes the manipulation of cobbing stones), others may cost as high as $15 or $18 and more dollars per ton. I believe that, including the breaking of the cobbing stones, $7 is the average cost of cobbing of asbestus for a ton at the leading mines of this section.

" The stuff, after being graded, which is, however, in the entire discretion of every particular mine, (prices of some No. 2 and No. 3 last year differed about 400 per cent), is put in bags of 100 pounds each. Cost of bags are from 5 to 6 cents each, cost of bagging, 20 to 25 cents per ton. The cost for transport to cars and loading on this section, vary from 10 to 60 cents a ton, according to distance from railroad.

**Asbestus.**

"To complete this part of my statement I may add that in this industry there are 40 boilers with a capacity of 1,825 horse power, and about 2,000 men employed. The value of plant, that is, machinery, buildings for stores and dwelling purposes, water reservoirs, roads, etc., is estimated at $355,000.

**Cost of mining, etc.**

"If I try to give now, in the following, an idea about the cost of asbestus mining, it must be understood that it cannot be applied to any individual mine. The cost of every one will naturally depend in first line upon the quality of the ground the mine is on, and upon how near the respective mine comes to the average with regard to purchase price, invested capital or plant, expenses of management, and so on. As to the quality of ground, I have, therefore, chosen to calculate the expenses on the ton of rock, and the cost of asbestus production will depend upon how many tons of rock, in a certain mine, have to be removed in order to produce one ton of asbestus. On this subject the opinions of the asbestus miners are considerably different, and while some claim to mine only on 50 or so tons of rock to the ton of asbestus, others go as high as 150. I am of the opinion that, as a rule, the quantity of rock mined to the ton of asbestus, is greatly underestimated. Basing, on the capacity and actual work of our machinery appliances, the known quantity of lorry loads removed from a mine during a year, and the known average weight of each load, in relation to the total of asbestus produced, I hold that 1 ton of asbestus to 100 tons of rock is a fair average. If we accept this, the cost of production of asbestus may be set down as follows: drilling, 3½ cents; blasting, 3 cents; labour for removing rock and gathering asbestus in the pits, 25 cents, making a total of 31½ cents to the ton of rock, or $31.50 to the ton of asbestus; $7 for cobbing; $1.50 for bags and bagging; 50 cents for loading; $5.50 for supplies that includes fuel, tools, iron, steel, timber, other materials and repairs; $6 for general business expenses, such as management, insurance, offices, marketing and others; $3.75, 10 per cent wear and tear, calculated on a total of $355,000 in plant and 9,000 tons production, making a total of $55.75 to produce one ton of asbestus. If we calculate now that we have to pay interest on a total invested capital of about two and one-quarter millions of dollars, for which at least 10 per cent must be expected, we have in our sales to average a price of at least $80 per ton of asbestus. Relating to the totals of production for the last eleven years, the figures at my disposal show for 1891 an output of nearly 9,000 tons, with a value of about $1,000,000, thereby ranking third or fourth as far as value of mineral production in the Dominion of Canada goes, being exceeded only by the coal production, valued at about seven and three-quarter

**Asbestus.**

**Growth of industry.**

million dollars, and on about even terms with copper, petroleum and brick. The output of asbestus in 1880 (eleven years ago) has been about 380 tons, amounting to $24,700. Since then the industry has steadily increased, with the only exception of 1888, and has reached in 1890, 9,860 tons, with a value of $1,260,240, taking the official figures as given by the Geological Survey, which, however, seem to me rather high, especially as far as the value is concerned. During the period between 1880 and 1890, the increase has been nearly 2,600 per cent in tonnage, and 5,100 per cent in value.

**Prices and market.**

"It may be interesting to see what the average value per ton for these last ten years has been, as this is the only measure by which we can judge the industry from a national and economic as well as a business point of view. The years 1880, 1881 and 1882 brought to the asbestus miners a price of $65 in average, while the price per ton in 1883 reached $72. From here we find the average price steadily decreasing, owing to the large proportions of No. 3 asbestus, until it reached the lowest point, in 1887, of $49. The respective figures are a trifle over $65 for 1884, $58 for 1885, $59.75 for 1886, and, as stated before, $49 for 1887; 1888 yielded an average of $60; 1889, $69.75, until 1890 brought the large figure of over $127 as an average price for every ton of asbestus, if the statements made by the Geological Survey are correct. This enormous increase in prices was due to several circumstances, chiefly relating to the state of the European market, and, in particular, that at the time a number of speculators had bought and kept from the market considerable amounts of stock in expectation of a further rise, while manufacturers as well were anxious to lay in as much stock as possible, under the impression that the mines had nearly reached the top of their capacity, and that prices would be driven to the utmost if stocks should run short. The real state of affairs transpired when the speculators tried to unload. Here a reaction set in, and while manufacturers before were very anxious to buy, they then decided to first await a settlement of the affairs. This, however, was promptly answered with the slacking down in the working of the mines last summer, and led in consequence and in consideration of other obnoxious circumstances—such as the Quebec Mining Act—to the entire shutting down of nearly all the mines in November last. Since then things have somewhat changed.

"It is clear that a mineral which has been successfully exposed to a heat of 4.500 to 5,000 degrees F., which is a non-conductor of electricity, and which may be spun like cotton and flax, has its merits in itself and will stand on those merits. The uses of asbestus are steadily increasing. I cannot, however, dwell on this point, and have to refer those

ASBESTUS.

Markets.

who are especially interested in the subject to an excellent paper read before the Asbestus Club in September last by Mr. Ed. Wertheim. One thing, though, I would like to mention with regard to the market for crude asbestus, and that is that it seems as if the American market is now rather inclined to buy as good grades as the European, while *vice versa*, manufacturers on the other side of the water are taking up lower grades along with first qualities—circumstances which never prevailed before. So it seems that those two main buyers of our products—America and Europe—are coming on more even terms than ever before.

"There is no doubt that the industry is still on a steady and very healthy increase, and while we may have temporarily to stand a slight reaction, things will brighten up before long. The sound judgment of those men interested in our industry will soon restore the balance between demand and production and will continue to develop the asbestus industry as wonderfully as they have done so far."

Exports and Imports.

Regarding the exports and imports of asbestus during 1891 and previous years, the following tables are self-explanatory.

ASBESTUS.

TABLE 1.

EXPORTS.

| Quality. | 1888. | | 1889. | | 1890. | | 1891. | |
|---|---|---|---|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. | Tons. | Value. | Tons. | Value. |
| **1st class**...... | 3,625 | $262,552 | 4,579 | $319,461 | 5,453 | $453,704 | 4,530 | $338,072 |
| **2nd** " ....... | 110 | 5,306 | 593 | 27,308 | 1,172 | 58,973 | 3,186 | 209,833 |
| **3rd** " .... . | 201 | 9,884 | 416 | 13,375 | 373 | 15,853 | 298 | 13,636 |
| Totals...... | 3,936 | $277,742 | 5,588 | $360,144 | 6,998 | $528,530 | 8,014 | $561,541 |

ASBESTUS.

TABLE 2.

IMPORTS.

| Fiscal Year. | Value. |
|---|---|
| 1885.................. | $ 674 |
| 1886.................. | 6,831 |
| 1887.................. | 7,836 |
| 1888.................. | 8,793 |
| 1889.................. | 9,943 |
| 1890.................. | 13,250 |
| 1891.................. | 13,298 |

**Coal.**

## COAL.

**Production.**

The production of this mineral for the whole Dominion is given i the accompanying graphic Table A, in Plate II., from which it will b seen that there is again a very encouraging increase in the figures o production over those of the previous year.

The 3,127,661 tons, valued at $6,496,110, returned for 1890, compared with the 3,623,076 tons, valued at $8,144,247, produced durin 1891, show the amount of this increase to have been 505,415 tons an $1,648,137. This result must be credited almost wholly to Britis Columbia. The greater proportionate increase in the figures of valu is also due to the greater proportion of this higher priced coal, include in the total.

From Table B, showing the proportion contributed to the gran total of tonnage by the several provinces, it will be seen that Nov Scotia still retains the chief place; British Columbia comes next i the amount of its production, whilst the North-west Territories an New Brunswick contribute but a relatively small proportion.

Table C speaks for itself.

The following Table No. 1 illustrative of coal mining in New Brunswick and the North-west Territories, explains itself:—

### COAL.

### TABLE 1.

### PRODUCTION IN NEW BRUNSWICK AND NORTH-WEST TERRITORIES.

| Year. | New Brunswick. | | North-west Territories. | |
|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. |
| 1887 | 10,940 | $ 23,607 | 74,152 | $ 157,577 |
| 1888 | 5,730 | 11,050 | 115,124 | 183,354 |
| 1889 | 5,673 | 11,133 | 97,364 | 179,640 |
| 1890 | 7,110 | 13,850 | 128,953 | 198,498 |
| 1891 | 5,422 | 11,030 | 174,131 | 437,243 |

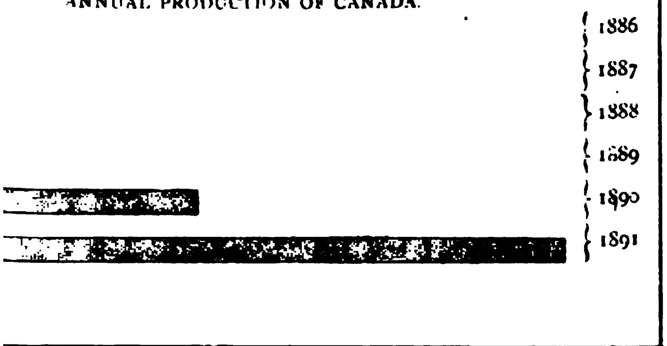
The amount and value of the coal exported from the country are given in Tables Nos. 2, 3 and 4 following, and in graphic Tables F and G.

PLATE II.

## COAL

### TABLE A

ANNUAL PRODUCTION OF CANADA.



I BY PROVINCES.

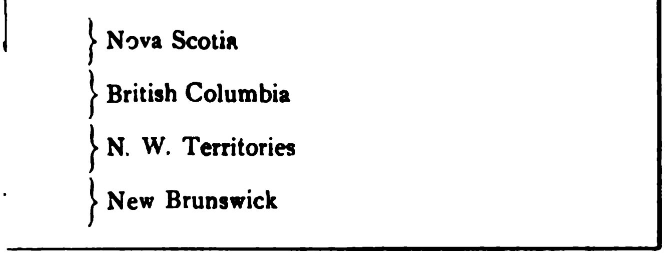
1891.

BLE B

MEN EMPLOYED ETC., BY PROVINCES.

1891.

### TABLE C



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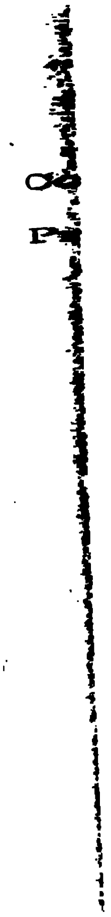
**COAL**

**Prod**

| ur | Tons |
|---|---|
| o | 700,861 |
| 1 | 754,031 |
| 2 | 984,664 |
| 3 | 1,117,643 |
| 4 | 977,446 |
| 5 | 848,395 |
| 6 | 794,803 |
| 7 | 848,395 |
| 8 | 863,081 |
| 9 | 882,863 |
| o | 1,156,635 |
| 1 | 1,259,182 |
| 2 | 1,529,708 |
| 3 | 1,593,259 |
| 4 | 1,556,010 |
| 5 | 1,514,470 |
| 6 | 1,682,924 |
| 7 | 1,871,338 |
| 8 | 1,989,263 |
| 9 | 1,967,032 |
| o | 2,222,081 |
| 1 | 2,290,935 |

| ar | Tons |
|---|---|
| 74 | 81,574 |
| 75 | 110,145 |
| 76 | 131,192 |
| 77 | 154,052 |
| 78 | 170,846 |
| 79 | 241,301 |
| 80 | 267,595 |
| 81 | 228,357 |
| 82 | 282,139 |
| 83 | 213,299 |
| 84 | 394,070 |
| 85 | 365,596 |
| 86 | 326,636 |
| 87 | 413,360 |
| 88 | 548,017 |
| 89 | 649,409 |
| 90 | 759,517 |
| 91 | 1,152,588 |


P
Q

Coal.

Exports.

## Coal.

### Table 2.

### Exports: The Produce of Canada.

| Province. | 1890. | | 1891. | |
|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. |
| Ontario.... ...... | 368 | $ 559 | ........ | ........ |
| Quebec.... ....... | 12,599 | 32,233 | 4,644 | $ 7,304 |
| Nova Scotia ........ | 202,387 | 426,070 | 194,867 | 417,816 |
| New Brunswick..... | 37 | 161 | 1,747 | 5,194 |
| Prince Edward Island | 142 | 478 | 35 | 109 |
| Manitoba . .. .. | 71 | 214 | 2,232 | 4,655 |
| British Columbia.... | 508,882 | 1,977,191 | 767,734 | 2,958,695 |
| Totals....... | 724,486 | $2,436,906 | 971,259 | $3,393,773 |

## Coal.

### Table 3.

### Exports: Not the Produce of Canada.

| Province. | 1890. | | 1891. | |
|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. |
| Ontario.......... | 63,251 | $150,258 | 63,777 | $158,416 |
| Quebec.... .. . | 13,185 | 31,042 | 11,565 | 25,953 |
| Nova Scotia...... | 5,784 | 15,055 | 2,319 | 6,217 |
| New Brunswick.. | 136 | 395 | 165 | 432 |
| Manitoba....... | 178 | 801 | 1 | 15 |
| Totals........ | 82,534 | $197,551 | 77,827 | $191,033 |

Exports and Imports.

### COAL.

### TABLE 4.

### EXPORTS: NOVA SCOTIA AND BRITISH COLUMBIA.

| Year. | Nova Scotia. | | British Columbia. | |
|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. |
| 1874 | 252,124 | $647,539 | 51,001 | $278,180 |
| 1875 | 179,626 | 404,351 | 65,842 | 356,018 |
| 1876 | 126,520 | 263,543 | 116,910 | 627,754 |
| 1877 | 173,389 | 352,453 | 118,252 | 590,263 |
| 1878 | 154,114 | 293,795 | 165,734 | 698,870 |
| 1879 | 113,742 | 203,407 | 186,094 | 608,845 |
| 1880 | 199,552 | 344,148 | 219,878 | 775,008 |
| 1881 | 193,081 | 311,721 | 187,791 | 622,965 |
| 1882 | 216,954 | 390,121 | 179,552 | 628,437 |
| 1883 | 192,795 | 336,088 | 271,214 | 946,271 |
| 1884 | 222,709 | 430,330 | 245,478 | 901,440 |
| 1885 | 176,287 | 349,650 | 250,191 | 1,000,764 |
| 1886 | 240,459 | 441,693 | 274,466 | 960,649 |
| 1887 | 207,941 | 390,738 | 356,657 | 1,262,552 |
| 1888 | 165,863 | 330,115 | 405,071 | 1,605,650 |
| 1889 | 186,608 | 396,830 | 470,683 | 1,918,263 |
| 1890 | 202,387 | 426,070 | 508,882 | 1,977,191 |
| 1891 | 194,867 | 417,816 | 767,734 | 2,958,695 |

The amount and value of Canada's imports of coal for this and past years is given in the tables below, Nos. 5, 6 and 7, which, it must be remembered, are for the fiscal year ending 30th June.

### COAL.

### TABLE 5.

### IMPORTS OF BITUMINOUS COAL.

| Fiscal Year. | Tons. | Value. |
|---|---|---|
| 1880 | 457,049 | $1,220,761 |
| 1881 | 587,024 | 1,741,568 |
| 1882 | 636,374 | 1,992,081 |
| 1883 | 911,629 | 2,996,198 |
| 1884 | 1,118,615 | 3,613,470 |
| 1885 | 1,011,875 | 3,197,539 |
| 1886 | 930,949 | 2,591,554 |
| 1887 | 1,149,792 | 3,126,225 |
| 1888 | 1,231,234 | 3,451,661 |
| 1889 | 1,248,540 | 3,255,171 |
| 1890 | 1,409,282 | 3,528,959 |
| 1891 | 1,598,855 | 4,060,896 |

COAL.

Imports.

### COAL.

### TABLE 6.

### IMPORTS OF ANTHRACITE COAL.

| Fiscal Year. | Tons. | Value. |
|---|---|---|
| 1880 | 516,729 | $1,509,960 |
| 1881 | 572,092 | 2,325,937 |
| 1882 | 638,273 | 2,666,356 |
| 1883 | 754,891 | 3,344,936 |
| 1884 | 868,000 | 3,831,283 |
| 1885 | 910,324 | 3,909,844 |
| 1886 | 995,425 | 4,028,050 |
| 1887 | 1,100,165 | 4,423,062 |
| 1888 | 2,138,627 | 5,291,875 |
| 1889 | 1,291,705 | 5,199,481 |
| 1890 | 1,201,335 | 4,595,727 |
| 1891 | 1,399,067 | 5,224,452 |

### COAL.

### TABLE 7.

### *IMPORTS OF COAL DUST.

| Fiscal Year. | Tons. | Value. |
|---|---|---|
| 1880 | 3,565 | $ 8,877 |
| 1881 | 337 | 666 |
| 1882 | 471 | 900 |
| 1883 | 8,154 | 10,082 |
| 1884 | 12,782 | 14,600 |
| 1885 | 20,185 | 20,412 |
| 1886 | 36,230 | 36,996 |
| 1887 | 31,401 | 33,178 |
| 1888 | 28,808 | 34,730 |
| 1889 | 39,980 | 47,139 |
| 1890 | 53,104 | 29,818 |
| 1891 | 60,127 | 36,130 |

*NOTE.—This table includes coal dust and all coal other than that specified as anthracite and bituminous.

Consumption.

An idea of the annual consumption of coal in Canada may be gained from the figures below, assuming that the imports, which are for the fiscal year, are about what they would be for the calendar year :—

| | Tons. |
|---|---|
| Production | 3,623,076 |
| Imports | 3,058,049 |
| | 6,681,125 |
| LESS—Exports | 1,049,086 |
| | 5,632,039 |

**Coal.**
**Markets.**

A reference to Table 11 will show that only about 8 per cent of the coal produced in Nova Scotia is shipped abroad, the sister colony of Newfoundland being our largest buyer, and the United States coming next, whilst the West Indies take a small quantity.

The other great producing district, that of British Columbia, finds a home market for about one-fifth of its production, and the largest proportion of the rest finds a market in California, while smaller consignments are sent to Alaska, China, Japan and the Hawaiian Islands, and a certain amount is utilized by the shipping on the Pacific.

**Nova Scotia.**

Nova Scotia—In Nova Scotia there were twenty collieries producing, their relative contributions to the output of the province being given in Table No. 8:—

COAL.

TABLE 8.

NOVA SCOTIA.

PRODUCTION BY COLLIERIES.

1891.

| Collieries. | 1888. | 1889. | 1890. | 1891. |
|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. |
| *Cumberland Co.* | | | | |
| Chignecto | 16,584 | 20,801 | 11,336 | 1,075 |
| Joggins | 54,261 | 50,870 | 68,181 | 67,263 |
| Minudie | 1,544 | 1,456 | .......... | 1,867 |
| Salt Springs | .......... | .......... | 157 | .......... |
| Springhill | 454,939 | 476,167 | 469,293 | 513,483 |
| *Pictou Co.* | | | | |
| Acadia | 325,620 | 301,960 | 307,924 | 319,617 |
| Black Diamond | 26,884 | 38,097 | 37,270 | 20,321 |
| East River | 879 | 1,730 | 1,523 | 3.276 |
| Holmes | .......... | 286 | 65,303 | .......... |
| Intercolonial | 177,708 | 141.072 | 120,668 | 157,615 |
| *Cape Breton Co.* | | | | |
| Blockhouse | 7,625 | .......... | .......... | .......... |
| Bridgeport | 27,134 | 24.076 | 31,610 | 34,605 |
| Caledonia | 126.318 | 128,015 | 174,915 | 179,183 |
| Francklyn | 9,230 | 4,531 | 810 | .......... |
| Gardner | .......... | .......... | .......... | 23,829 |
| Glace Bay | 89,431 | 90,630 | 124,848 | 131,899 |
| Gowrie | 145,018 | 125,104 | 158,031 | 177,032 |
| International | 114,429 | 138,785 | 160,262 | 149.161 |
| Ontario | 5,166 | 3,210 | 10,135 | 3,484 |
| Reserve | 135,650 | 136,247 | 174,615 | 191,345 |
| Sydney | 170,224 | 162,362 | 203,359 | 191,174 |
| Victoria | 100,619 | 121,633 | 101,841 | 124,361 |
| *Inverness Co.* | | | | |
| Broad Cove | .......... | .......... | .......... | 175 |
| Rankin | .......... | .......... | .......... | 179 |
| Totals | 1.989,263 | 1,967,032 | 2,222,081 | 2,290,935 |

Coal.
Nova Scotia.

The above table, together with all those here given relating to Nova Scotia, are compiled from material provided by the Government Department of Mines of that province. The details of the coal trade of the province are given in tables Nos. 9, 10 and 11 below :—

### COAL.
### TABLE 9.
### NOVA SCOTIA.
### PRODUCTION, SALES AND COLLIERY CONSUMPTION.

| Period. | Production. | Sales. | Colliery Consumption. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| 1891—First quarter.............. | 404,460 | 247,306 | 41,384 |
| " Second " .............. | 629,534 | 542,269 | 57,965 |
| " Third " .............. | 729,531 | 794,606 | 51,807 |
| " Fourth " .............. | 527,410 | 487,757 | 44,825 |
| " Totals................. | 2,290,935 | 2,071,938 | 195,981 |
| 1890 " ................. | 2,222,081 | 2,000,444 | 180,589 |
| 1889 " ................. | 1,967,032 | 1,741,720 | 177,106 |
| 1888 " ................. | 1,989,263 | 1,765,895 | 176,336 |
| 1887 " ................. | 1,871,338 | 1,702,046 | 156,550 |
| 1886 " ................. | 1,682,924 | 1,538,504 | 159,512 |
| 1885 " ................. | 1,514,470 | 1,405,051 | 142,939 |

### COAL.
### TABLE 10.
### NOVA SCOTIA.
### COAL TRADE BY COUNTIES.

| YEAR 1891. | CUMBERLAND. | | PICTOU. | | CAPE BRETON. | | INVERNESS. | |
|---|---|---|---|---|---|---|---|---|
| | Raised. | Sold. | Raised. | Sold. | Raised. | Sold. | Raised. | Sold. |
| | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. |
| First quarter. | 137,944 | 122,160 | 118,978 | 95,207 | 147,363 | 29,771 | 175 | 168 |
| Second " | 146,917 | 130,827 | 126,309 | 111,610 | 356,308 | 299,832 | ........ | ..... |
| Third " | 141,721 | 123,872 | 129,177 | 129,583 | 458,633 | 541,151 | .. ... | ... |
| Fourth " | 157,106 | 140,880 | 126,365 | 117,307 | 243,760 | 229,525 | 179 | 45 |
| Totals..... | 583,688 | 517,739 | 500,829 | 453,707 | 1,206,064 | 1,100,279 | 354 | 213 |
| 1890......... | 548,966 | 491,241 | 532,700 | 482,170 | 1,140,415 | 1,027,033 | ....... | ..... |

COAL.
Nova Scotia.

### COAL.

### TABLE 11.

### DISTRIBUTION OF COAL SOLD.

| Market. | 1890. | 1891. |
|---|---|---|
| | Tons. | Tons. |
| Nova Scotia :— | | |
| Transported by land.......... | 390,322 | 404,031 |
| " sea........ | 283,869 | 312,474 |
| Total............ | 674,191 | 716,505 |
| New Brunswick............. | 251,749 | 256,833 |
| Prince Edward Island........... | 62,544 | 75,570 |
| Quebec..................... | 842,163 | 868,320 |
| Newfoundland................ | 107,557 | 121,651 |
| West Indies................. | 5,284 | 4,576 |
| United States................ | 56,956 | 28,483 |
| Total............. | 2,000,444 | 2,071,938 |

Discovery and development in Nova Scotia.

The details of discovery and development in this province, as gleaned from the report of the Department of Mines* of Nova Scotia, are as follows :—

"The returns show a sale during the past year of 1,849,945 tons against 1,786,111 tons during the preceding year. The increase was not as large as anticipated in the spring, and the explosion at the Springhill collieries, reported on in the report for the year 1890, reduced the output of Cumberland county by about 30,000 tons.

"As compared with the sales of the year 1890 the most noticeable points are :—

"The home sales were 639,737 tons compared with 601,956 tons in 1890.

"The province of Quebec took 775,286 tons against 751,931 tons in 1890.

"The sales to the United States were 2,585 tons of round, 58 tons of run of mine, and 22,788 tons of slack coal, in all 25,431 tons, as compared with 50,854 tons in 1890.

*Cumberland County.*

"The sales to Newfoundland and New Brunswick, Prince Edward Island and other points show little difference.

"The sales of the county were 462,267 tons against 438,608 tons in 1890.

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*The ton mentioned in the following quotations from this source is the long ton of 2,240 lbs.

COAL.
Discovery and development in Nova Scotia.

"The production of the collieries of the Cumberland Railway and Coal Company was 459,395 against 419,012 tons in 1890, in spite of the delay caused by the explosion. Since that date the enlargement and completion of the air-way has been finished. New pumps, screens, etc., have been put in, and the colliery generally placed in excellent order. Safety lamps alone are used underground, and no explosives.

"The Chignecto mine has remained closed, and no returns of a satisfactory character have been received of the results of the prospecting carried on for other seams.

"A little work has been done on the Maccan River collieries by Mr. Smith and others. Mr. Sharp of Amherst, and others, have traced the Styles seams further to the east, and added materially to our knowledge of this part of the district.

"At the Joggins mines the system of long wall has been continued, and improvements made to the railway and wharf. The output was 60,056 tons.

### *Pictou County.*

"The sales were 405,096 tons as compared with 430,509 tons in 1890.

"The home sales were 265,098 against 277,753 tons in 1890.

"The province of Quebec took 63,219 tons compared with 90,461 tons in 1890.

"The output of the Acadia Company was 286,372 tons, and of the Intercolonial Company 140,728 tons. The Black Diamond colliery was purchased by the Acadia Company, which will continue the extraction of the pillars, etc.

"At the Albion colliery the work of reopening the Ford pit has been continued with success.

*Intercolonial Coal Mining Company, Westville.*—"The principal work in this mine during the past year has been extracting the pillars on the 3,000 feet lift; on the north side the pillars have been very satisfactorily drawn, and all the plant from that side taken to the south side. A large proportion of the work done was in the S. Holmes area, in which they are successfully mining a large percentage of coals. There are yet, however, on their own area, a block of coal, 450′ × 1,800′, standing with (4) four back-balances driven up to mine bord on next lift. A tail-rope running with 22 boxes on each trip is used on this level, and has proved an economical feature in underground haulage, and from the success obtained in its use I would wish to draw to it special attention, as

COAL.
Discovery and development in Nova Scotia.

with it in this district one boy can alone do the work that hitherto (8) eight horses and as many drivers were required to do, which success, I trust, will induce others to follow the example. From this level a tunnel has been turned off to strike the Scott pit seam ; the tunnel, it is computed, will require to be driven a distance of (600) six hundred feet, and to strike the seam down a distance of about 3,000 feet from the surface. As the Scott pit seam improves in quality to the dip, it is believed that at this point the coal will be of extra good quality. On the lift below this the levels have been driven in on each side a distance of about (600) six hundred feet, and they intend driving them until the line is reached on each side, before extracting the coal, any further than to put up balances for returns, and then bring back the pillars on the fresh timber. There is sufficient coal on the 3,000 feet lift to keep the mine working until the levels in the lower lift are in to the line. The Scott pit is now idle, and will remain so until the next season's shipping begins. The management intend to commence sinking another lift of (600) six hundred feet. The new winding engine, of which I made mention in last year's report, hoists (11) eleven boxes each trip.

"Considerable expenses have been incurred this year in building the most important of which was a new brick engine house for the hoisting engine, also a new car shop ; and the bank house being too small, was enlarged.

*Acadia Mine, Westville.*—"In last year's report I made mention of the difficulties they had to contend with in this mine, viz., firedamp and bad roof. I regret to say that in this respect during this year the difficulty has not lessened, but increased. This mine has a perpendicular depth of about 1,500 feet, and as the coal is tender and contains a large percentage of gas, the enormous pressure causes the gas to evolve from roof, pavement and sides, and the mine being as well very dusty, it is therefore difficult to manage. * * * * * All the workmen are now in the 3,560 feet lift, as the 3,100 feet lift is finished ; the pressure was so great on this lift that some little coal was lost in the finishing up, being the first coal lost in this mine in my time ; the air returns were damaged some, but are pretty well opened up now. The new hoisting engine is giving good satisfaction, also the new pump. It is difficult to describe the difficulties met with in a mine of this description, and only the men who work in it, and the management who anxiously conduct it, can fully estimate or realize the trouble and cost of keeping air-ways open, and the mine in good order and safety.

COAL.

Discovery and development in Nova Scotia

*Vale Colliery, Thorburn—Six Foot Seam.*—"In my last report I spoke of the introduction of the long-wall system. This has been carried on during the year in the lower lift 2,000 feet down, but is not meeting with the desired success; the roof is of a very strong nature, and the slips run into the coal face, giving considerable trouble, making it expensive to keep the working faces open. On the 1,000 feet lift during the year, pillar work principally has been carried on with very good results. Some very heavy feeders of water have been struck in this mine, entailing considerable loss and expense, as the pumps were of insufficient capacity to keep the water out; they were obliged to flood the lower mine bord, causing them to carry the air for hundreds of feet with brattice, and the bottom being of a soft nature, caused falls in the mine bord, which had to be cleaved and timbered. The management were obliged to place two new Knowles pumps in the mine; these pumps throw about 560 gallons per minute. The mine was partly idle for 7 or 8 weeks until the pumps were started, reducing the output of coal considerably. The following buildings, viz., the locomotive shop, carpenter's shops, office, stables, store house and boiler house, were moved from the McBean slope and put up at this mine, and caused considerable expense in so doing. Culm is used in firing the boilers instead of coal. Now that everything is placed and the mine in good order, I would not be surprised to hear of a larger output of coal next year.

*McBean Seam, Thorburn.*—"No attempt has been made to open up this mine during the past year.

*McGregor Pit, Stellarton.*—"At my official visitation of this mine, on 24th April, I found the pillar work spoken of in last year's report stopped, and masons busily employed building them off, the temperature kept continually rising, and as it was beginning to get alarmingly high, the management, after careful survey, decided it was all but on fire, and therefore determined to close up this portion of the mine with brick, stone, sand, &c. Through the past summer the north and south slants have been connected at the bottom, and as in consequence the north engine can hoist all the coal, the south engine is idle, and in future can be used for sinking purposes. Two new back-balances have been started off during the year, but as there is now a very large area of this mine resting on pillars, it is not desirable to make very rapid progress until the overlying seams are dealt with, but as these seams are now being developed, it is only a matter of time until the pillars can be safely drawn. The depth of the mine is now about 2,670 feet down, angle of descent from 16° to 25°.

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*Foord Pit.*—"It has been found necessary in the development of this mine to build some very extensive brick arches, the roof having been broken to such a height it was supposed the air was getting into the old workings. The stone arches around the bottom of the shaft were very much wrecked by the fire, and there is now some 500 feet of brick arch about the bottom, all well filled and packed at the back with sand, thus making them air-tight, and giving a soft rest to the pressure. The bottom now looks very well. Quite a number of other large brick stoppings have been built. Two slants have been sunk to the dip, a distance of about 400 feet, and still sinking. Soon they will be mining the coal from the deep.

"The coal-cutting machine did not prove as satisfactory as anticipated; the lower part of the seam having some very hard boulders, it was not quite able to cope with them. Some changes are now being made in the machine to meet this difficulty. The pit-head gear has been renewed and the latest improved screens and tipples fitted up. and everything around the pit-head is new. Fifty new coke ovens have been built, and a tunnel driven to conduct the gas from the ovens to the boilers to utilize the gas for raising steam in lieu of coal, which must undoubtedly result in great economy of labour and coal.

"On one side of the mine the temperature is about 80°, and necessitates a considerable quantity of air to keep it cool enough for the men to work; and as they proceed to the dip the gas makes freely, and, unless greater power be used, there is no means of increasing the volume of air, and as it is necessary to obtain increased air-way, the English slopes that were sunk 1,700 or 1,800 feet have been started sinking again, and a place turned off the north level of the Foord pit to cross-cut the measures and meet the slants; thus as there are two slants, when completed, will make a good travelling-way and air-way, and give a good field of coal, giving the Foord pit two more seams, viz., the Cage pit and four feet seam immediately overlying it, all down hill for the coal excepting through the tunnel, which will be about 300 or 400 feet, and as the water now finds it way to the Foord pit they will not experience much difficulty from that source. There has been some five or six places driven into the old works, which would seem to indicate some errors in the old plans. These places had to be built off with iron rails and brick and sand. They have had many difficulties to contend with, but so far every difficulty has been met, and this mine is again assuming its usual appearance.

"*Third Seam Slopes.*—It is understood that the Cage pit and Third Seam are connected by a tunnel some 250 feet in length, and the

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tension of this tunnel has cut another 4 feet seam of the best coal pro- bly in this county and a band of iron stone which carries 45 per cent iron. It takes time to advance levels and get new works like this ened out, but I am pleased to say that this has been systematically d quickly done. During the year there was a back-balance driven on the north side of Third Seam, and nine bords turned away, and e levels extended a considerable distance beyond.

"On the south side there has been a balance with 8 bords worked t nearly, and the levels extended. In the Cage pit seam the levels north and south side have been rapidly extended and balances iven up.

"In the Four Feet Seam the levels are also being extended and ıces driven up hill. Some of the iron has been taken out and roasted the mine with satisfactory results. This seam of coal will be worked ıg wall.

*Spring Hill Mines.* —"It is unnecessary for me to say anything at ıgth in reference to the explosion which occurred here on the 21st last February, the investigation having been published in last year's port.

* * * * * *

"It was only two weeks after the explosion when the mine was ain being partially worked, the damage underground being slight ıen we think of the terrible loss of life. These collieries are now nparatively clear of gas. At the working faces there are times ıen a few inches is found by the fire-boss, more especially in up-hill ıces where the brattice is not kept close up; but as to gas being in ınding places or old work, I never found it, nor do I know of any ın who ever did. The overlying strata in Cumberland county does t carry firedamp like the Pictou county coal seams. The Pictou ınty coal basin has for its cover bituminous shale, while Cumber- ıd county coal basin has more freestone and fireclay, which counts for being less gas than in Pictou collieries. Safety lamps the only kind of light now used in this mine. Explosives are not ed.

"There has been quite a lot of work done in the air-ways, and the ume of air considerably increased. The new lift which was sunk t year in the east slope has been opened up this year, and levels ven east and west. During the year the west slope has been sunk wn to 1,200 feet. There is also a new lift in the north slope, and one the east slope 600 feet each, and 1,200 feet in the west. Properly eaking, we do not know the extent this lift may be driven west- ırdly, as every year further developments are made of this seam esterly, until now they are proven for some miles with slight varia-

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tions southerly, caused by up-throw dikes or faults. Easterly the No. 5 slope is proved to some extent a distance of one mile, roughly speaking.

" There are somewhere about 1,400 men and boys employed in these mines, and when we take into consideration the hazardous nature of their employment the casualties that do occur are comparatively few. During the year there has been placed in the north slope a new duplex pump--high and low pressure, water barrel 10 inches, stroke 36 inches, water-column 10½ inches ; the pipes are lined inside with wood.

*Joggins Mines.*—" All the work done in this mine during the year was long wall. It has proved very successful here, as the coal taken out under this system is larger, and a larger percentage of coal is won. I would say that 95 per cent of all the coal is taken out, it may require more timber, but the larger percentage of coal obtained amply pays the difference. The men also can dig a larger quantity per shift than under the old system.

" The water level has been cleaned and timbered from the shore to the slope, a distance of one mile and an eighth.

" Formerly the road for delivering the coal at shipping, which was one mile and an eighth in length, was laid with double tracks and operated by an endless rope, the engine operating it being at the mine. The coal was then dumped into a chute of about 150 feet in length, and run into the vessels lying at the wharf, of which only one could be loaded at a time. During the past year the whole business has been remodelled. At the wharf, instead of the chute, in the same place there have been two tracks laid and the wharf extended, and several places made in which vessels can lie and be loaded at the same time with different kinds of coal. At the head of these two tracks is placed a drum barrel with brake attached, and the full boxes running down bring up the empty ones. Instead of two tracks from the pit and an endless rope, there is now only one track with sufficient descent in it for the full boxes to run down with rope attached, and the engine then pulls back the empty ones, thus doing away with half of the track and rope formerly used.

" The mine is now in order to yield a large output of coal. There has been no gas reported in this mine during the year, and during the same time has been free from any kind of accidents.

" No explosives are used in working the coal ; the powder and dynamite used was in stone, and in cutting through a large fault in three places, and some brushing for horse roads.

*Minudie.* " This mine was worked for two or three months last winter, and then remained idle until the middle of November, when it

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rted again with 10 or 12 men, the object being local sales for iter.

*son Mine.*—"This mine was idle for two or three months during nmer on account of their engine-house being destroyed by fire. been rebuilt, and the mine at work again with from 8 to 10 men ed in it.

*necto Mines.*—"This mine was worked during the winter along p, a few men being employed getting out coal for local sales. spring Frank Burrows, the underground manager, started ting the property. He was supplied with a diamond drill, of drilling 1,000 feet, and had 10 to 12 men employed, and has ny last visit, December 1st, continued at work, and has drilled of holes from near Athol station to the Stoney half-mile. I he had drilled through some of the coal measures. He has illed three holes of about 600 feet depth each, and has began to e fourth.

*a.*—"Alexander Dewar, reported as having 3 or 4 men employed mine, ceased operations at the end of the year, and has not resince.

*k Diamond Mine.*—"Principally pillar work done here during r. They are getting along very successfully and mining a good age of coal. It is now under the management and control of adia Coal Company, Limited.

*River Area—John Muir and Sons.*—"Work has been carried just as usual.

November 28 and 30 I visited Leicester in Cumberland county, coal was reported to have been discovered. I found Mr. Sharp with 6 men east of the Styles mine, on the bank of a brook. 5 seams of coal exposed; about sixty feet of measures were n the first three seams, which appeared in thickness to be as : 1st seam, 3 feet; 2nd seam, 5 feet 4 inches; 3rd seam, 3 feet s. Then 107 yards south were the other two seams, one 6 feet other 9 feet, dipping south 10° west at an angle of 45°.

ere are good indications further east, lots of drift coal on the and a good level country. I cannot probably do justice to this of the country, as the crop-out of the seams appeared disturbed. saw any coal burn better than it does in a stove.

### *Cape Breton County.*

e total sales for this county were 982,392 tons against 916,994 1890.

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"The increase was principally in the home sales and those to the province of Quebec.

"During the past year the Gardener mine was got into good working order by the Burchell Bros., who introduced a Jeffrey's electrical coal-cutting machine. The Sydney and Louisburg Coal and Railway Company reopened the Emery seam. Both these mines are said to yield a coal adapted for steamer uses. Preparations are being made for introducing mechanical coal-cutting machinery into several mines in the Cape Breton district. As a result of the construction of the Cape Breton Railway, coal from this district is burned on the Eastern Extension Railway.

"Prospecting was carried on at several points in Cape Breton county, and it is claimed that a new and workable seam has been found underlying the Gardener seam. Such a seam would prove, owing to the great extent of country it would underly, a great addition to the coal resources of the Island.

"At East Bay, Mr. Young, on behalf of some American capitalists, has been engaged in sinking on a bed of hard coal, and will continue with better sinking appliances in the spring.

"The Mabou Gypsum Company have opened one of the Mabou seams and sold a few tons. The seam is 7½ feet thick and of good quality. A wharf has been built, and it is expected that next summer a considerable trade will be done with Nova Scotia and Prince Edward Island.

*Sydney Mines.*—"The north side pump deep has been driven further to the dip and a new landing opened there, 291 yards below the old landing. No. 1 angle deep, south side of pit bottom, has been driven through the trouble and extended, so that a new landing has been opened at 330 yards further to the dip than the old landing ; also No. 2 angle deep, south side, has been extended and a new landing opened out 330 yards further to the dip than the old one.

"A new and larger spur wheel has been put on the north side underground engine to increase its hauling capacity. A new Jack engine drum and ropes have been put in for lowering and drawing the men from the pit. Also the back of the cages are boarded in and an iron bar placed across the front for safety.

"The ventilating fan has been much improved in efficiency by tacking sheet rubber to the periphery or margin of the blades, also by enlarging the outlet for the escaping air. A second new apparatus has been erected to help the filling away of the bank coal during shipping season. Cast iron tubing has been provided with which to line the

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pumping shaft at points where the stone is wasting away by reason of the heat from the steam of the underground engine.

"The heapstead pit tops, boiler seats, and engine houses, have been lighted by electric lights. A small horizontal engine and dynamo have been put up for that purpose, all of which gives satisfaction.

*Victoria Mines.*—"Work has been brisk at this mine during the last season. Since my last report the east levels in the 1,800 feet lift has been driven 380 yards, and another balance has been driven up. The west levels in the same lift have been driven about 150 yards; and a balance won out. The 1,200 feet east levels have also been extended about 400 yards.

"Stoping has been successfully carried on during the shipping season. A new angle deep has been driven off the main east slope, at a much lighter angle of dip, for the purpose of shortening the haulage in the level by horses; and also to enable the surface hauling engine to bring out a much larger trip of coal each time. The west levels in the 1,200 feet lift in the west slope have been standing nearly all this season, and only one balance is being worked at present; but the main slope is being driven down to win out another lift of 600 feet. The new engine for the fan mentioned in my last report has been placed and working for some months.

"A tubular boiler, 14½ feet long and 5 feet diameter, with 75 tubes in it, has been placed near the fan, and is quite able to supply the two fan engines with steam.

"A new fan shaft, 8 feet square and 40 feet deep, has been sunk and connecting with the main air-way.

"The erection of another Champion or Murphy fan, 8 feet diameter, has commenced. They have also put in another common egg end boiler, 36 feet by 5 feet 4 inches diameter, in place of two small ones. A gangway was erected in the spring between the coal bank and heapstead, and a donkey engine placed underneath it to draw the coal to the screens.

*Lingan.*—"A few men have been working in the pit there this season, getting out some coal which has been taken to Sydney Mines to make coke of.

*Gardener Mine.*—"Since last report this mine has been dried, equipped, and put in operation. Its condition was found to be better than was anticipated. Engine-house, forge, office, and dwelling-house are all being repaired, also a new store has been built. The heapstead has been finished, the shaft has been cribbed, buntings and guides put in. The two Cameron pumps that remained in the mine under water

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for about twelve years were in good condition, and with slight repairs are found to be all that is necessary for keeping the mine dry.

"The air-shaft has been cribbed and the water that formerly used to go down it has been dammed off. Ladders are placed in it for the workmen's convenience. In the latter part of the season the air was changed from its former course bringing it in a shorter direction to where the men work ; this made a marked improvement in the ventilation.

"The bottom of the main roads both north and south of the pit bottom have been blasted up, admitting the use of larger horses for hauling ; also the management has disposed of the tubs formerly used in this mine, and instead are using on the south side of the pit a tub of double the capacity.

"The extension of the south level and the next rooms above it shows a marked improvement in the thickness of the seam. The Jeffery coal-cutting machine has worked steadily since August ; the results attained are satisfactory. A gradual gain is made as the men get more acquainted with the machine.

"Mr. Burchell informs me that in the latter part of December a cutting of 270 square feet was made by the machine with two men in three and one half hours, which would be equal to 770 square feet in a shift of 10 hours. The electrical plant was manufactured by Messrs. A. Robb & Sons, Amherst, N.S. This plant, besides furnishing power for the machine, supplies the engine-house and bankhead with electric light.

*Caledonia.*—"During the last season the main or west deeps have been extended about 600 feet, and two sections on both sides won and opened there. The west high lift levels have been extended and rooms broken off. The levels on the east side from the bottom of the 700 feet deep slant have also been extended and a large section opened out.

"The workings to the rise were carried on as usual. A line of stone stoppings has been built and put in place of where the wood and board stoppings were, from the furnace to the lower landing on the main deep. A second furnace of the same size has been added to the former one : it is built on the east side, and the escaping air goes from both through the same shaft and cupola. This furnace ventilates the east side of the pit and the former the west side, both having separate inlets and returns, all of which have made a great improvement in the ventilation. On surface a new building of 100 x 28 feet has been erected, to be used as a forge and a carpenter's work-shop. A new stone boiler-house has also been built.

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*Old Bridgeport.*—"A new incline plane 900 feet long has been driven and put in operation from the south side of the pit bottom towards the rise. The south levels have been extended, and are now about 1,600 feet from the bottom of the shaft. The ventilation has been greatly improved in this mine during the past season.

"Stoppings have been put up along the levels, headways and through the rooms where required, also a return air-way has been driven from the south side of the high workings direct to the back part of the furnace, giving two returns.

*Reserve Mines.*—"This mine has been worked pretty busily during the last season. The French or east slope has been driven down 350 feet further, and levels turned off south and north. The south levels were driven 600 feet, and the north levels about 450 feet. A new landing has been made there and a fine section of rooms opened out. The coal is hauled from this section by means of a new steel wire rope leading from one of the engines on surface to the low landing. The trip is taken from this landing to the upper landing, when it is caught there by another rope and engine drawing it to the surface; this works remarkably well. Very little time is lost in unhooking from the empty and hooking on the full trip, and *vice versa.* The pillars have been nearly all drawn from the west side of the main slope. Work ceased there in October. A new cupola has been built on the east side instead of the old one that was blown down in October by a heavy gale.

*Emery Mines.*—"The dip slants have been driven about 650 feet and rooms broken off and worked during the latter part of the season. The north levels on the high lift have been extended about 650 feet, and the south side levels 320 feet. As the dips are extended the coal seems to improve in quality and thickness of seam.

*Ontario Mines.*—"Mr. Alexander McPherson commenced in the latter part of last March to secure and timber the slope and horse roads, and also to pump the water out of the dip. He succeeded while the weather remained dry, but as soon as the fall rain came he found that he was unable to keep the water down, so he finally abandoned the work. However, during the season he mined coal from a few rooms on the south side of the slope, below the high level.

*Gowrie Mines.*—"This mine has worked in its usual systematic way during the most part of the year. From the bottom of the west deep slant a horse road has been driven northerly over the fault, and a pair of levels turned off and driven westerly a distance of 300 yards, and a section won out between the fault and the anticlinal.

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Also, south and parallel to the fault the levels have been extended westerly 200 yards.

"A good travelling road for the workmen has been made from this district to the high level near the pit bottom. On the east side main deep, where the roof was considered dangerous, 150 yards of it has been taken down an average thickness of 3 feet, and the place well secured with timber 1 foot or more in diameter.

"The levels going east have been driven 300 yards, and those going west extended about 400 yards, those levels have struck the fault that is leading from the west dip slant.

*Little Glace Bay.*—"During the past year the north levels have been driven about 900 feet, the south levels have been stopped, leaving a large barrier between them and the seashore at the harbour. The management has commenced driving a new deep on the south side of the pit bottom, with the intention of gaining a lift of 600 feet.

"A new shaft 40 feet deep and 8½ feet square has been sunk as an air-shaft, and an 8-foot fan placed in position. This is called the Murphy ventilating fan, and is reversible, the same as the one at the International. It works admirably well, and will be used as a blow-down this winter if required.

"A new double-acting 12-inch fire pump, with 9-inch columns, is being put in for the purpose of relieving the pumps now in use. A new block of four tenants are added to the workmen's houses. A new block of crib-work, 160 feet long, has been built and placed on the southern side of the harbour for its protection.

*International Mines.*—"The south side slant deep road has been extended down 600 feet deep, and another landing opened out there. This is the second landing on that road below the main level.

"The main overcast north side of pit bottom has been reconstructed in the shape of an arch with old railroad rails bent for that purpose. They make a good strong arch and suit well where the roof is bad. They are lasting and can be moved to any other part of the pit for the same purpose if required.

"An air-shaft has been sunk 90 feet deep, 10 feet diameter, and an 8-feet fan, known as the Murphy ventilator, erected there. It is so constructed that it can be made to either exhaust or blow down, and is at present working as a blow-down, but the intention of the management is to have it exhaust in summer seasons. It is capable of giving 80,000 cubic feet of air per minute if required. There have also been two new locomotives purchased and running during the past season in place of two of the old ones.

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*'cAdam's Lake, East Bay.*—" Prospecting has been going on at this ; during part of the season by American capitalists. * * * * iaft 65 feet deep by 8 feet long, and 4 ft. 6 in. in width, has been : on a seam of very black shale. There are several seams of this ; showing on both sides of a brook that runs down towards the crossing the strata.

*riboo Cove.*—" I visited this mine on the 18th of December, and d twenty-two men employed there. A shaft has been sunk 130 deep, 14 feet by 6 feet, divided in three compartments. The ı of coal that it is sunk on is called the 7-feet seam, but has not proved as yet to be over 3 feet 9 inches thick. The coal is hard burns well.

A new engine-house has been built and a double cylinder friction ing engine, 35 horse-power, put in position; also a pumping ne, 7-inch cylinder, 15-inch stroke, and a portable boiler 10 by 5 diameter. This engine, besides pumping the water from the shaft, es a fan which ventilates the pit.

A level has been driven from the seashore in on the 11-foot seam, stance of 125 feet, and well timbered. A new dwelling-house has built, an office, barn and forge. The company operating this reside in Rhode Island, U.S. President of the company, W. B. ks; secretary, T. A. Buel; underground manager, James W. on. The management says it is the intention to ship coal early spring."

ıe following shows the average thickness of the coal seams now ed in the dip workings in Cape Breton mines:—

| Name of Mines. | Thickness of Seam. | |
|---|---|---|
| | Feet. | Inches. |
| Sydney Mines | 5 | 6 |
| Victoria Mines | 6 | 8 |
| Gardner Mines | 4 | 4 |
| Old Bridgeport Mines | 5 | 9 |
| Reserve Mines | 8 | 9 |
| Emery Mines | 4 | 9 |
| International Mines | 5 | 10 |
| Little Glace Bay Mines | 5 | 10 |
| Caledonia Mines | 8 | 6 |
| Ontario Mines | 8 | 4 |
| Gowrie Mines | 5 | 8 |

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NEW BRUNSWICK.—For this province, a total production of 5,422 tons, valued at $11,030, has been reported. As formerly, it all results from operations on the seams of the Grand Lake coal field. These operations continue to be of the desultory nature and limited extent of those of past years, resulting mostly from the work of the inhabitants of the district for short periods on the small seams found there.

The work is done near the surface, and the coal obtained is used locally in the provinces.

The nature of these operations can be judged when it is pointed out that the returns show that the number of men employed by the different operators, varied from two to eight, working for periods of from two to nine months.

Some of the operators complain that the industry is crippled by lack of good roads and of railroad communications, and by the scarcity of miners in the district.

*East Albert Company's Property.*—Prospecting has been done on this property by the New Brunswick Mineral Developing Company. The work done so far shows three small vertical veins of albertite, running a little south of east, the largest measuring about twelve inches in width. The Albert mines are still idle.

NORTH-WEST TERRITORIES.—The amount of coal produced in this region, viz., 174,131 tons, shows an increase over last year of 45,178 tons. Returns were received from operators located at various points in the Territories. Of the mines mentioned, the only three that were worked extensively were those of the Alberta Railway and Coal Company, with mines at Lethbridge; the Canada North-west Coal and Lumber Syndicate, with mines at Canmore in the Cascade Coal Basin, where the coal produced is a semi-anthracite, and those of Messrs. H. W. McNeill & Co., working in the same basin.

The latter company commenced operations in June, having leased the mines of the Canadian Anthracite Coal Company, and it is reported that a vigorous policy has been inaugurated with a view to taking rank amongst the chief producers of Canada.

Mr. R. G. McConnell, of the Geological Survey Staff, in his report to the director speaks as follows of the results of his work in this district during a short period in the spring:—

"This work was carried out during the month of June and was undertaken with a view of ascertaining whether the coal-bearing Cretaceous rocks of the Cascade basin recur east of the mountains. The section along the Bow proved to be too complicated and was intercepted by too many concealed intervals to trace the sequence of the formations

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definitely throughout, but sufficient evidence was collected to show that in all probability the conglomeritic beds exposed at the Kananaskis Falls are the equivalents of those overlying Marsh's mine, south of the Gap siding in the Cascade basin, and that the underlying dark shales consequently represent the coal-bearing formation. East of the mouth of the Kananaskis the conglomerates and underlying shales fold over a light anticlinal, and several hundred feet of the latter are exposed without any coal seams being seen. The summit of this anticlinal, which occurs three-quarters of a mile east of the mouth of the Kananaskis River, offers the most favourable site for testing by means of a bore hole for the presence of coal. The coal horizon of Marsh's mine, assuming the identification of the conglomerates to be correct, lies at this point at a depth of 1,300 feet below the surface. There is, however, no absolute certainty that even if this depth was reached coal would be obtained, owing to the lack of persistence of the Cretaceous coal seams, and on the other hand workable seams might be struck at a much less depth. The rocks near the mouth of the Kananaskis River are comparatively undisturbed, and coal, if present, would be much less crushed and also more easily worked than is the case with many of the seams inclosed between the more highly inclined beds of the Cascade basin, and on this account a bore hole to test its presence would be desirable."

The remainder of the coal production credited to this region, results from the operations of farmers and others working for longer or shorter periods during the year, in the outcroppings of lignite and lignitic coal found on their properties, for the purpose of meeting a local demand for fuel in a district where wood is scarce.

These seldom employ more than three or four men, and that only for a few months during the year, the total annual production of any one amounting to but a few hundred tons. The seat of these activities is chiefly in the vicinity of Calgary, in the foothills of the Rocky Mountains, about the creeks forming the headwaters of the Bow and Belly rivers, and to the northward, in the vicinity of Edmonton.

Similar operations have been inaugurated in the Souris and Turtle Mountain districts, south-west from Brandon, in the province of Manitoba.

British Columbia.

BRITISH COLUMBIA.—In this province, the coal-mining industry shows a most encouraging increase of over fifty per cent on the figures for 1890. See graphic Table E.

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Production, etc., in British Columbia.

The following tables, Nos. 12 and 13, give statistical data regarding the industry, and afford a means of comparison between the two years, 1890 and 1891 :—

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### TABLE 12.

### BRITISH COLUMBIA.

### PRODUCTION, SALES, &C., FOR 1891.

| Name of Colliery. | Coal raised. | Sold for home consumption. | Sold for exportation. | On hand, 1st Jan., 1891. | On hand, 1st Jan., 1892. | Number of men employed. |
|---|---|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. | Tons. | |
| Nanaimo ... | 590,751 | 157,652 | 429,952 | 6,802 | 9,949 | 1,464 |
| Wellington .... | 386,604 | 61,291 | 316,346 | 2,794 | 11,760 | 957 |
| E. Wellington.. | 46,666 | 7,748 | 40,523 | 1,605 | ........ | 188 |
| Union. ..... | 128,567 | 329 | 116,435 | 3,720 | 15,523 | 585 |
| Totals. .... | 1,152,588 | 227,020 | 903,256 | 14,921 | 37,232 | 3,194 |

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### TABLE 13.

### BRITISH COLUMBIA.

### PRODUCTION, SALES, &C., FOR 1890.

| Name of Colliery. | Coal raised. | Sold for home consumption. | Sold for exportation. | On hand, 1st Jan., 1890. | On hand, 1st Jan., 1891. | Number of men employed. |
|---|---|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. | Tons. | |
| Nanaimo ..... | 436,246 | 110,141 | 327,946 | 10,744 | 6,802 | 1,493 |
| Wellington ... | 195,436 | 78,141 | 119,035 | 3,416 | 2,794 | 646 |
| E. Wellington.. | 49,954 | 9,502 | 39,348 | 612 | 1,605 | 170 |
| Union......... | 77,881 | 1,659 | 82,933 | 10,431 | 3,720 | 350 |
| Totals...... | 759,517 | 199,443 | 569,262 | 25,203 | 14,921 | 2,659 |

COAL.

Markets for British Columbia coal.

The details given below are quoted from the report of the Minister of Mines for the province to show the present condition of the industry, and its progress during the year :*—

"Continuing the statements of the various sources from which California, our chief foreign market for coal, is supplied with that commodity, I beg leave to submit hereunder a statement compiled up to the end of 1891, from an authentic commercial source :—

| | 1888.<br>Tons.* | 1889.<br>Tons.* | 1890.<br>Tons.* | 1891.<br>Tons.* |
|---|---|---|---|---|
| British Columbia | 345,681 | 417,904† | 350,388 | 517,477‡ |
| Australia | 271,612 | 408,032 | 153,920 | 275,490 |
| England and Wales | 126,167 | 32,890 | 53,374 | 200,777 |
| Scotland | 10,680 | 12,727 | 1,490 | 34,225 |
| U. S. Eastern States | 30,118 | 18,950 | 32,701 | 42,237 |
| Puget Sound | 568,948 | 372,514 | 450,762 | 393,163 |
| Coos Bay and Mount Diablo | 81,194 | 87,600 | 74,210 | 90,684 |
| Japan | 13,808 | 1,340 | 13,250 | 20,506 |
| Carmel Bay | | | | 1,200 |
| Alaska | | | | 150 |
| Total at San Francisco | 1,448,208 | 1,351,957 | 1,130,095 | 1,575,909 |
| At Lower Ports, viz. : Wilmington, San Pedro, and San Diego, in California | 211,598 | 11,805 | 123,312 | 160,820 |
| Total California | 1,659,806 | 1,363,762 | 1,253,407 | 1,736,729 |

"The totals above stated are of the quantities of coal actually received into California, while some of the coal shipped in 1891 from this province, destined for that state, would be on the way and not arrive until 1892. And, on the other hand, some of the coal shipped in the province in 1890 would have arrived there in 1891, and be included in the above statement. The last year's total of coal delivered by collieries of this province and Washington State, also Coos Bay, in Oregon, called in the market 'Coast Collieries,' together with the totals of 'foreign' shipments (other than those of this province), shows a growing power of absorption of our great 'natural product' of coal, by our friendly neighbours and customers of many years past, that is most gratifying from a commercial and industrial point of view. It will be seen that in 1888 California touched the present total within about 77,000 tons, so that it may be hoped that a total of two

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* The ton mentioned in the following quotation from this source is the long ton of 2,240 lbs.

† Some of this export, as of other exports in this column, were delivered at lower ports in Carlifornia, but the returns in 1889 did not distinguish the quantities, beyond the 11,805 tons. There were altogether 139,060 tons from various sources delivered at lower ports in 1889.

‡ In addition to this export of 517,477 tons from British Columbia, there was an export to and delivery at lower ports, from the province, of 123,534 tons, which is included in the 160,820 tons, noted as delivered at lower ports.

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millions will soon become the normal amount of coal consumption in California, with a rapid progressive increase, and that by wise legislation and negotiation on the part of Dominion statesmen, a treaty of reciprocity with the United States, in the article of coal, may enable our coal industry to hold its own against the severe competition it has now to sustain from the cheaper mined coal of other countries, as well as to maintain and increase our enormously developed capacity for production of this necessary staple article, of undoubted quality and utility, proved and established in the market.

"Owing to the absence of an equitable reciprocity treaty between Canada and the United States, within the past few months excessive shipments of coal from distant countries to California have so disturbed the balance of supply and demand that existed during the greater part of the past year, that a prudent diminution of output and shipment of coal took place generally from the collieries of this province, in order to ease off the glut that was brought about by such extraordinary deliveries into California, and it is calculated that early in the spring the market will have assumed its normal condition, and that the collieries of British Columbia will be worked up to their highest power, with a brisk trade, which is a result devoutly to be wished for, on behalf of our very numerous and deserving body of miners in this province, who have been for some time working only four days or less a week, while their personal, family and household expenses have been going on all the time at full rate. Otherwise, I can truly say that the collieries of Nanaimo, Wellington, and Comox were never in better condition than now, and that prospects never looked so well for putting out coal; and it may be expected that after the present lull in the coal market blows off, we shall see every mine worked to its full capacity and to the best advantage of all concerned.

Development and discovery.

"*Nanaimo Colliery.*—With the exception of a few days at the end of the year, the coal has been in good demand from this colliery during the past year.

"*No. 1 Pit, Esplanade, in Nanaimo.*—This mine, being part of the Nanaimo Colliery, belongs to the New Vancouver Coal Mining and Land Company, Limited, and is a most valuable mining property, with resources of coal that are practically inexhaustible. Now, as in previous years, the workings from No. 1 pit have been from what are known as the Nos. 1 and 2 north levels. The No. 1 level is from the bottom of the shaft (or pit), in a northerly direction, going under the water of Nanaimo Harbour, with its windings, for about two miles, being the longest underground hauling road of any colliery in the district. The face of the level is under Protection (or Douglas) Island.

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Coal in here has been very good. The level is not working at present, but it stands on good coal. The coal is worked from this level on the pillar and stall system, and will average about six feet in thickness. In some parts it is thin, but at other places it is thick, and will be about the average named. All the work, for about 1,400 yards, has been on the west side, and much of this is not started away from the level. On the east side it is all solid for the above-mentioned distance; except near to the face there is a slope down 300 yards in good coal all the distance. The object of this slope is to connect with the shaft being sunk on Protection Island, which I shall refer to under its own heading.

"No. 3 level is also in good coal, and from this level a considerable quantity of coal has been taken out through the year. There has been much rock work here, but now they have got into good coal, about seven and a half feet thick, and to all appearances they have got into the same tract of excellent coal that they have been and are now working in the No. 1 level, but a long distance to the eastward of No. 1.

"Ventilation in this mine is good. When I was down in December, I found that there were 59,600 cubic feet of air passing per minute for the use of 120 men and 18 mules—23,400 feet to No. 1 level, and to No. 3 level, 36,200. The motive power to keep this volume of air circulating consists of two double fans, on the Murphy principle, on the up-cast (or No. 2) shaft, driven by steam engines, with water gauge eight-tenths. Very little gas has so far been discovered in this mine, and there is also freedom from dust.

"The management have been making great preparations in the levels, and tramways, underground, and also on the surface, for carrying out the purpose of the company to have the coal brought from those long roads to the shaft by electricity, so that in about a month, or as soon as the electric works are completed, an opportunity will be afforded of seeing the electric motors hauling the coal under the harbour, and the ships in the harbour taking the coal away to the other countries.

"*No. 3. Pit (Chase River), Nanaimo Colliery.*—This mine of the New Vancouver Coal Company has worked steadily most of the year, excepting a day occasionally for repairs. The coal from this pit has been exceptionally good, both as regards hardness and quality. As I have previously mentioned the workings here are on the pillar and stall system, and during the year, up to the 12th October, nearly all the mining had been at those pillars, but on the above date the company suspended work, and the mules, etc., were taken out of the mine. There is, however, a considerable quantity of coal

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obtainable in the mine, and it is the intention of the manager to let it stand till the coming summer, or till late in the spring.

"Ventilation was always good; at the time the mine stopped 45,000 cubic feet of air were passing per minute for the use of 40 men and 8 mules. The motive power here was a large fan on the up-cast shaft.

"*Southfield Mines, Nos. 1 and 2.*—Both are known as the Southfield mine of the New Vancouver Coal Company. The mine is worked by a slope, down 800 yards, but there has not been much mining done near the bottom. It has been and is now the greatest producing mine of the extensive Nanaimo colliery. The coal is hard and good. In some places the coal is 12 feet thick, much of it with a strong conglomerate roof close to the coal, making it safe to work with ordinary care. Much of the mining here is now done at the pillars, which represent fully one-third of the whole original seam of coal. Besides this, coal has been mined in stalls. This has been and is now a valuable mine, but the company have had, and yet have, faults to contend with in the workings.

"Ventilation, good; motive power, a large fan. This mine is worked on the separate split system, having three splits—two to the south and one to the north side of the slope. When I was down in December, there were 98,000 cubic feet of air passing per minute for 130 men and 9 mules. There is seldom any gas. The mine is also free from dust.

"*No. 4, Southfield Mine.*—In this slope a great deal of work has been done. The prospects not being encouraging work has been stopped for the present. Another shaft has been put down to the coal further to the dip—the shaft next mentioned as

"*No. 5 Pit, Southfield.*—In a previous report you will have seen that this shaft of the New Vancouver Coal Company, was down 100 feet, and that their trouble was then commencing, as the water was coming in freely, while the rock was very hard; but perseverance, in most cases, is sure to be rewarded, and in this case it was, for, after the company had persevered against water and hard rock, the coal was struck at the depth of 508 feet, and proved six feet and a half thick. It was somewhat soft in the bottom of the shaft, but as they worked out it got better, and is now much improved and a fine vein of coal. In starting a new work like this, after the coal is reached, there is a large amount of work to be done in the way of headgear, engines, railway, and many other things that an onlooker does not notice, and they all take time. Now they have started in earnest, and appearances are most favourable here for a good mine. This shaft is to the dip of both

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Southfield Nos. 1 and 2 and No. 4 mine, and is quite a valuable acquisition to the New Vancouver Coal Co.'s colliery, and it is sincerely hoped by all their well-wishers—and they are many—that this mine will roll out the coal for years to come. This coal is much wanted in the California market, and always commands the highest market price when it is taken there.

"*Protection Island Shaft.*—This is the property and new work of the New Vancouver Coal Company, and is on the south point of Protection (or Douglas) Island, and on the north side of Nanaimo Harbour. The workings of No. 1 shaft, Esplanade, Nanaimo, extend under this island, and the company knowing that the coal was good, but having a long distance to haul it underground, and judging from the character of the formation on the surface along the coast line and into the sea that, in all likelihood, the coal extended for miles, concluded to put this shaft down on the island. The contract for sinking the shaft was let early in the spring of 1891, and on the 12th of March work commenced, and has continued on to the finish almost without a stoppage of any kind until the 12th of January of this year, when it was successfully finished at a depth of 670 feet. The size of the shaft is 18 by 12 feet in the finish, timbered with plank four inches thick, and with a partition dividing it into two compartments from top to bottom. Here, as was expected, the coal is five feet thick. On the 22nd January, 1892, they holed through on to the slope mentioned, as put down near to the face of No. 1 level in No. 1 shaft, and, after arrangements are complete, that will be the intake for the air of No. 1 level, which will be a great relief to that mine. The air will only have to go through, in place of having to go in and come out. Although the shaft is down, there is yet much work to be done before they can say that they have got fairly started to ship coal from the Protection Island shaft.

"The company are now erecting a large double hoisting engine, which will be the machine for taking out the coal from this place. The cylinders of this engine are 26 inches, with 42-inch stroke. It was made by the Hamilton Manufacturing Co., Peterborough, Ont. The headgear is also framed and put together, ready for hoisting into position, but, in addition to what is already accomplished, there is much to be done, viz., the putting up, and the fillings about the pit head. There is only a short piece of railway to make, and that is nearly ready for the rails. There is a complete set of new wharfs to build, which will have to be done before much coal can be taken away from this new pit, but from what I have seen this company do, I am satisfied that all the works required here will be carried on with the

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greatest speed, so that they may be able to take coal into the ships for foreign ports. With the great prospects here for coal, and the largest ships being able to go within 400 feet of the mouth of the shaft, the company will be able to compete for putting the coal into the market as cheaply, if not at less price, than any that can oppose them.

"The New Vancouver Coal Company has made a large outlay of capital, but it would be hard to represent the vast amount of coal that stands in view against the outlay, and to all appearance this is going to be the coal mine of Nanaimo.

"*Northfield Mine, Nanaimo Colliery.*—This mine, mentioned in a previous report, is in the northern part of the extensive estate of the New Vancouver Coal Mining and Land Company, hence the name Northfield, which seems to be very appropriate, as in the other end of the estate there is the Southfield mine. This mine is entered by a shaft, and from the bottom of the shaft there is the south level, and on the north side there is also a level of this name; but the principal part of the mining at present is from a slope starting from near the shaft on this side, running about north-east.

"Work has been going on steadily during the past year, except on occasions that could not well be avoided, as the repairing day must come to all works where machinery is one of the prime movers. The coal from the Northfield mine is hard and of a very good quality. It is in brisk demand in the Victoria (B.C.) and California markets, and in other places where it has been introduced always commands the highest price.

' The coal is worked on the longwall system, from the levels and both sides of the slope, and is of a varied thickness of from two to four feet.

"Ventilation is good, but owing to the system in use the air goes along the face, and about shot-firing time in some places there is smoke, quite a large quantity of powder being used. The ventilation being on the separate split system, the smoke soon goes past. When I was down, in December, I found that there were 62,640 cubic feet of air passing per minute for the use of 130 men and 5 mules, and in the following divisions: two main splits from the shaft to the north and south sides; to the north split there were 30,960 cubic feet; this goes down the slope, and is again divided to each side along the face of the workings to where it has to leave them, when it goes along the air-way to the up-cast shaft. On the south side there was 31,680 cubic feet passing per minute. This went in by the south level and returned by the way of the face (coal) to the up-cast shaft. There is little or no gas in the mine, which is also free from dust.

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"*The Harewood Estate (Nanaimo Colliery).*—This estate is now the property of the New Vancouver Coal Mining and Land Company. Considerable prospecting has been done on this estate at different times, but the company got the diamond drill to work during the past summer, at about one mile and a half in a south-east direction from the old Harewood mine. This bore-hole got on well, and when down 150 feet they struck the coal, which proved by boring to be five feet six inches thick. They were so well satisfied with the prospects that they commenced to sink a shaft as soon as tools and machinery could be got on the ground, and expect to reach the coal early in the spring. It is to be hoped that this company will be successful in their enterprise. Previous to the company acquiring the property, two parties attempted coal mining here, but both failed to make it a success, and I trust that it now remains for the New Vancouver Coal Company to be the winning party.

"*Prospecting by the New V. C. Co.*—There has been much prospecting and exploring by the New Vancouver Coal Company. In addition to the sinking of the shaft mentioned, they have just put down a series of bores in their Northfield estate, and from the encouragement afforded by the prospects of those bores, we may expect to see a shaft started in the Northfield estate soon.

"*Wellington Colliery—No. 1 Pit.*—This pit is near to Departure Bay, and was put down to the coal about fourteen years ago, but excepting a little coal taken out of one of the upper seams, no mining was performed. Work was resumed here about four months ago to erect machinery and all the necessary works for the sinking of a shaft. As this shaft was only a small hole, they started at the surface to enlarge it to the usual size of the shafts in this colliery, expecting to reach the coal early in the spring. The calculation is that good coal will be found here, which will be good for the district, as well as for Messrs. Dunsmuir & Sons.

"*No. 3 Pit, Wellington Colliery.*—With the exception of keeping the water out, there has been little or no mining done here, yet there is quite a large quantity of coal to come out of this shaft.

"*No. 4 Pit, Wellington Colliery.*—This pit is about 1,000 yards to the east of No. 3 shaft, and is connected by a good travelling road to the same. Here, as in all the working mines of this colliery, the men have been working regularly during the past year, except a day now and again to perform repairs that were necessary. The coal is in good demand in the California market and in other places to where it was sent, as well as by steam-boats calling for fuel, and for home consump-

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"This mine is worked on the pillar and stall system, and in some districts there has been much mining done, in taking out the pillars, which are fully a third of the whole. The coal is hard, and of the usual good quality of the Wellington coal. This is a very extensive mine, being well spread out. It is worked in four districts, viz., south, east, north, and west. No expense is spared to make the works safe. Ventilation is very good. Motive power, a large fan on the up-cast shaft, which is about 500 yards north of No. 4 shaft. The south side is ventilated from No. 3 pit. You will have seen that this mine is ventilated on the separate split system. The air is split at the bottom of the shaft, taking, what are called, the north and south sides. That going to the south is diverted to the east level, and that to the north is for the north and west workings, and, as I have said, the south side is ventilated from No. 3 pit. When I was down in December I found that there were 130,400 cubic feet of air passing per minute, with a velocity of 1,450 feet per minute, and this was for 196 men and 18 mules. The mine is free from coal dust, but in some places they have a regular system of pipes to put water on, where or when it might be required.

"In addition to the manager there is a general superintendent, and the overman and fireman, besides a staff of shot lighters, to examine and see that everything is safe before a shot can be fired, and also to examine the place after the shot is fired, to see that the place is safe, and to give instructions if it is otherwise. The staff use safety lamps only, and in the absence of the overman have all the power that is necessary to have everything that may be found or appear to be dangerous made safe. There is now very little gas to be found in this mine.

"*No. 5 Pit, Wellington Colliery.*—As mentioned in a previous report, this is the only mine of the Wellington Colliery that has connection with the Esquimalt and Nanaimo Railway, by which the principal part of this famous coal which is used in Victoria finds its way to the market. To this mine Messrs. Dunsmuir & Sons have also an extension of their own railway system in connection with their shipping point at Departure Bay.

"In this pit, as in the other mines of this colliery, the men have been working steadily the most of the year, except a day occasionally during the past two months.

"This is a very extensive mine. The coal is brought to the shaft from the east by a level, from the north by a slope, and from the south and west by a self-acting incline. In the east the coal is mined on the pillar and stall system: in the slope it is longwall, and in the south

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and west incline all the mining is at the pillars (coal) which contains fully one-half of the whole which was in the district. In the longwall, down the slope, there is a long face working of about half a mile in one stretch, all good coal, without a fault of the smallest kind, and from four and a half to eight feet thick, so that in all the districts of this mine it never looked better nor had as good an opening for taking out coal as there is now.

"Ventilation is very good. Motive power, a large fan on the upcast shaft driven by a steam engine. When I was down, in December, I found that there were 112,222 cubic feet of air passing for the use of 197 men and 19 mules; fan making 99 revolutions per minute; water gauge $\frac{8}{10}$ of an inch. This mine is ventilated on the separate split system, the three main divisions being at the bottom of the shaft, to the east level, 35,340 cubic feet per minute, which is again split away further in the level, for the use of 70 men and 10 mules. There were 32,860 feet per minute going down the slope, this being also divided into two currents down the slope, and being for 80 men and 3 mules. In the south incline and west level there were 44,020 cubic feet circulating per minute, for 47 men and 6 mules. In this division it will be observed, that there are the least men, but most air passing. That is owing to the fact that all the mining being done here is at the pillars (coal) and sothat all the caves from the roof may be kept clear. There is very little gas now found here, but occasionally it is seen in the longwall workings, when there is a fall of rock, and then not often, as there is a strong air blowing along the face. This mine is also free from coal dust.

"In addition to the overman and fireman, there is a staff of shot lighters and examiners in each district. These men have to be in all the places at different times every shift, so that very little that happens can escape their notice. They cannot be long in one place unless something special requires them to stay.

"*No. 6 Pit, Wellington Colliery.*—This pit is mentioned in a previous report as being about 900 yards east of No. 4 pit, yet the workings of the two mines are quite close to each other, leaving a solid strip of about 40 yards, as it is not intended that the two should be connected. This will be an extensive mine, there being a very large area of ground solid in coal to be takenout. Coal is hard, and of the usual good quality of the Wellington seam, varying in thickness from four to eight feet. There is much of this mine worked on the pillar and stall system, which works well; but there are two other districts where longwall is found to work well, and this is the favourite work of this mine for getting coal.

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"Ventilation is very good, and on the separate split system; there are five separate splits in the air, all of them near to the bottom of the shaft, three on the east and two on the west side from the shaft, and the air is well conducted to the face of the pillar and stall working, by brattice and otherwise. In the longwall works the air goes along the face, some escaping at each road, is caught when it gets to the face; this keeps the roadway free from any impurities. In December last, when I was down, there were 75,000 cubic feet of air passing per minute. The motive power of this is a fan on the same shaft as the coal is hoisted from, there being a tight partition in the shaft, and one-half of the shaft being the intake and the other the exhaust.

"The air passing as above per minute is for the use of 130 men and 8 mules. There is very little gas found in this mine, but what is found comes mostly from the roof in the longwall, when it breaks up in holes.

"This pit is now connected and has a travelling road to No. 5 pit; the connection is only in one place; and there are doors, so that one pit cannot injure the other by taking away the air; both being independent, except the travelling road.

"This mine is free from coal dust; it is not what can be called a wet mine, and yet it is not dry.

"*No. 2 Slope, Wellington Colliery.*—There has not been any work done here during the past year.

"*Alexandra Mine.*—This mine belongs to Messrs. Dunsmuir & Sons, and is about one mile south of the Southfield mine of the New Vancouver Coal Company's Nanaimo colliery. There has not been any work done here during the last year, but I have been informed that it is expected something will be done with this place in the spring.

"*East Wellington Colliery.*—This colliery belongs to the East Wellington Coal Company, and comprises two shafts.

"In No. 1 pit only a few men are mining coal, and that is near to the No. 2 pit. The coal is of excellent quality, hard, but thin for what is known as the Wellington seam. The coal on the west side of this shaft is getting well worked out. On the east side, or what is called the east level, there has not been any regular vein of coal yet, but they are working in the place where the coal should be, and there are yet good hopes that there will be good coal got in this side, which is where the larger area of the company's land is situated, and the expectation is that it will in the near future prove to the company that it is the most valuable part of their property in this district.

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"*No. 2 Pit, East Wellington.*—In this pit they have been working steadily all the year, except when repairs have been needed. Coal is good and is in full demand in the San Francisco market.

"This mine, as well as the No. 1 mine of this company, is worked on the longwall system, although the roof is very soft, and the coal has been considerably broken, which makes it very difficult to work. There is quite a large body of coal in sight, with narrow roads run into it. Some of the places look well, and it is hoped that these prospects will not disappoint the fair expectations raised by them, as the company and its management have been persevering and pressing forward, and are highly deserving of success.

"Ventilation is good. Motive power a fan, erected near the top of No. 1 pit, which is the up-cast for both No. 1 and No. 2 pits. When I was down in December I found there were 20,000 cubic feet of air passing per minute for the use of 35 men and 5 mules. This current is split at the bottom of No. 2 shaft; 5,000 per minute going to those in the west side, and 15,000 to the east side, but both connect and go in one volume to the No. 1 pit. This being longwall working, the greater part of the air goes along the face, the remainder escaping at the roads and keeping them clear. There is very little gas seen in this mine, there not being much chance for it to collect, the old works being well filled in nearly every particular, and every precaution is taken to prevent accidents of any kind. In addition to the manager and overman, there are three firemen, one on each shift of eight hours, going about the works. As there are not many miners working the fireman can see all the places frequently during the day.

"*Union Colliery, Comox.*—This colliery belongs to the Union Colliery Company. The mines are only a few miles from the extensive farming settlement of Comox, with a good road thereto. There have been three mines on three veins here, but at present the company are working in two of the veins. The upper seam (or vein) comes out on the hill in the south side of the railway, and into this there are the Nos. 1 and 2 tunnels or adit levels. No. 1, the lowest one, is in about 600 feet; No. 2 is in about 1,000 feet. Coal is hard and of a good quality, and from two to three feet thick, with a strong sandstone rock for a roof. This is mined on the longwall system, making very safe workings.

"Ventilation very good. Motive power a furnace; the air going in both tunnels and returning by the way of the face of the workings. There has not been any gas found in this mine, and it is free from dust.

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"*No. 1 Shaft, Union Colliery.*—There is nothing being done here at present, and there has been very little done during the past year.

"*No. 1 Slope, Union Colliery.*—This slope is mentioned in a previous report as down about 700 yards. There are three levels from this slope to the north side. The coal here is of good quality and very hard, but they are much troubled with faults, although it is improving as they go north, and now it varies in thickness from three to seven feet. This is worked on the pillar and stall principle; some of the places are very soft, and in other places it is very strong.

"Ventilation good. Motive power a fan on Murphy principle, driven by a steam engine. This mine is ventilated on the separate split system, the intake being the slope, afterwards it is split into two divisions, one for No. 4 level and the other for No. 3; after going round the working places it again gets into one volume and goes along the air-way and out at the up-cast shaft. When I was down in December I found that there were 23,400 cubic feet of air passing in this mine per minute, for the use of 70 miners. The mine gives off some gas, as the roof is soft in some places and it falls out, leaving a hole, and those are the places that give the trouble. There is a fireman on each shift to examine and attend to the safety of the mine, in conjunction with the overman. There is no dust in this mine, it being wet throughout.

"*No. 4 Slope, Union Colliery.*—This is the new mine mentioned in my former report as No. 2 slope, and then just getting opened out. This is now down about 400 yards. The coal is of varied thickness, from five to eight feet for the whole distance.

"The coal is very hard and of good quality; in texture it resembles Wellington coal. The engineer of one of the large steam-ships that load here informed me that it gave better results than any coal he has used on the coast. At the face of the slope just now the coal is seven feet thick and hard, proving a most valuable piece of property to the company. This mine is worked on the pillar and stall system, the works being to both sides of the slope. They are now taking about 400 tons of coal per day from this mine.

"Ventilation is very good, and on the separate split system. The laying out of the mine is very well arranged for proper ventilation; motive power is a fan. In December, on my inspection, there were 39,200 cubic feet of air passing per minute, the fan running slow, for the use of 100 men. The mine is free from dust. There is no gas in the mine.

"From what the management know, by a series of bore-holes, great work is expected from this place, and no expense is spared to put it in first-class order.

COAL. Discovery and development. —British Columbia.

"There is a large trestle work from the entrance of this mine, rising gradually until it gets to the height required; then there is quite a long flat place where the cars that come out of the mine can stand, so that little energy is used to make them go either way. The car dumping or tipping appliances here are the finest and easiest on coal, so as not to break it, of any in the province, and quite a mechanical invention. The loaded car goes on to the tipper just enough to let the coal out, when it comes back again to the level and the next car comes along, sends the first car over the machine and gets on to a lower level, then runs back nearly to the top of the slope, or far enough to fill in when there is a train of them. The connection between the hoisting and tail ropes seems to work to perfection, one or two men being able to handle all the coal that can be brought from the mine. At this mine there is also a large double winding engine, specially constructed and geared to double drums, which is the mode used here and seems to work very well. The steam engine and machinery for both the tipping and hauling came from the Eastern States.

"In this mine the company have introduced, and have been working for the past five months, coal mining machinery from the Jeffrey Manufacturing Company, Columbus, Ohio; operated by electricity. With the exception of the coal mining machines, the engines, dynamos, and all other appliances are out on the surface about 300 feet from the entrance of the mine; the connection being made to the mine by heavy wire, which is easily connected to the coal mining plant, of which there are four different motors with coal cutters. Either one or all four can be used as required, and at any place, just to suit where work is wanted to be done. They do good work, and, what is about the hardest to do, viz., undermining, this being the work that they are made for. The machines, when at work, stand end on to the face of the coal, with the cutter bar three feet three inches long; this at regular distances from each other is set with teeth, so that there is four inches cut, neither more nor less. After the machine is set in motion, in four minutes it has undermined a hole close to the floor three feet three inches wide, six feet in the face and four inches high; when it has done this work it comes out again, and then it is put over for another cut, which takes about five minutes, and so on nntil the place is all undermined, when a shot in each corner will bring all the coal down that is undermined. About one of the best day's work that one of these machines has done here was to undermine ninety feet long and six feet deep; this must have been a great saving in powder and coal, not to say anything in the saving of labour.

COAL. Discovery and development.—British Columbia.

"*Tumbo Island Coal Mining Company.*—The island of the above name is situated at the south-east entrance of the Straits of Georgia, and about two miles north-west of East Point Lighthouse. There has been but little work done here during the past year. The old company have negotiated with another party, who has started in earnest and is now sinking a shaft on the south side of the island, this having been previously bored to the coal at the depth of 325 feet. It is hoped that the company will make a successful find in this valuable property. A colliery here will not be out of the way for steam-boats going between Victoria and the mainland, and would also be most convenient for the coaling of the China steam-ships, as they go close past, within hailing distance. A good colliery here would be a fine thing for the company having the same, and also for the province in general.

"*Nanaimo Colliery.*—Name of seams or pits—Southfield No. 2, Southfield No. 3, Southfield No. 5, No. 1 Esplanade shaft, and No. 1 Northfield shaft.

"Value of plant—$350,000.

"Description of seams, tunnels, levels, shafts, &c., and number of same—Southfield No. 2, worked by slope, seam 6 to 10 feet; Southfield No. 3, worked by shaft, seam 5 to 10 feet; Southfield No. 5, worked by shaft, seam 5 to 10 feet; No. 1 Esplanade shaft, worked by shaft, seam 5 to 12 feet; No. 1 Northfield shaft, worked by shaft, seam 4 feet 6 inches.

"Description of length of tramway, plant, &c.—Railway to Southfield, 6 miles, with sidings; railway to No. 1 shaft, 1 mile, with sidings; railway from Northfield mine to wharf at Departure Bay, 4½ miles; rails are of steel, 56 pounds per yard, of standard gauge, viz., 4 feet 8½ inches; 8 hauling and pumping engines; 15 steam pumps; 5 locomotives; 200 coal cars (6 tons), besides lumber and ballast cars; fitting shops for machinery repairs, with turning lathes, boring, drilling, planing, screw-cutting machines, hydraulic press, steam hammer, &c., &c.; diamond boring machinery for exploratory work (bores to 4,000 feet); wharfs, 1,070 feet frontage, at which ships of the largest size can load at all stages of the tide.

"*Wellington Colliery.*—Name of seams or pits—Wellington.

"Value of plant—$150,000.

"Description of seams, tunnels, levels, shafts, &c., and number of same—4 shafts with slopes, air-ways and levels; 3 air shafts; 1 sl[illegible] sinking.

"Description and length of tramway, plant, &c.—5 miles of railway, with sidings and branches; 6 locomotives; 250 coal cars; 13 stat[illegible]

COAL. Discovery and development.—British Columbia.

ary engines; 9 steam pumps; 4 wharfs for loading vessels; and bunkers.

"*East Wellington Colliery.*—Name of seams or pits—East Wellington Coal Co.'s Nos. 1 and 2 shafts.

"Value of plant—$100,000.

"Description of seams, tunnels, levels, shafts, &c., and number of same—1 seam, 2½ to 7½ feet; 2 shafts; 7 levels.

"Description and length of tramway, plant, &c.—4½ miles standard narrow gauge; 2 locomotives; 31 (4½-ton) coal cars; 2 hoisting engines; 2 donkey engines; 1 steam pile driver; 1 steam saw-mill, capacity 12,000 feet per day; 5 steam pumps.

"*Union Colliery.*—Name of seams or pits—Union and Lake.

"Value of plant—$100,000.

"Description of seams, tunnels, levels shafts, &c., and number of same—Nos. 1, 2, and 4 slope, with air-ways and levels; Nos. 1 and 2 tunnels.

"Description and length of tramway, plant, &c.—12 miles of railway, 4 feet 8½ inches gauge; 4 locomotives; 100 coal cars, 25 tons each; 1 diamond drill; 3 stationary engines; 3 steam pumps; 1 steam sawmill; 2 wharfs; 1 pile hammer."

Nicola Valley

Apart from the coal production of the above described districts, the coal of the interior was mined in the Tertiary rocks of the Nicola Valley. This was a very small amount and was for local consumption only.

Crow's Nest Pass.

Attention has been directed, however, and a great deal of interest taken in the coal occurring in the vicinity of the Crow's Nest Pass, which crosses the divide between the province and the Territories. To this place the director of the Geological Survey paid a visit of inspection in July, the results of which he gives as follows:—

"On the 30th of July we camped at Lee's Lake, on the Crow's Nest Pass trail. On the 31st Col. Baker joined me here, and on the following day we camped at the east end of Crow's Nest Lake, and on the next day, 2nd of August, we reached the coal prospecting camp situated about 1,200 feet above the trail, on the ridge which runs in a northeasterly direction between Marten Creek and Michel Creek and forms the west side of the valley of the west branch of Michel Creek. From this ridge a number of spurs with steep intervening gullies descend abruptly to the trail; in these and on the intervening ridges a wonderful series of coal seams is disclosed, one above the other from near the level of the trail to the summit of the ridge.

COAL.

Crow's Nest Pass.

"No exact measurements were taken and it may be that some of the lower cannel seams are the upper ones repeated by faulting. The outcrops which can all be seen on the ground are as follows, twenty seams in all, showing a total thickness of 132 feet of coal :

| | Feet. | |
|---|---|---|
| No. 1 | 5 | No. 1 to 10 inclusive are cannel coals. |
| 2 | 3 | |
| 3 | 4 | |
| 4 | 2 | |
| 5 | 4 | |
| 6 | 3 | |
| 7 | 2 | |
| 8 | 4 | |
| 9 | 5 | |
| 10 | 6 | |
| 11 | 4 | |
| 12 (Peter seam) | 15 | |
| 13 | 7 | |
| 14 (Selwyn seam) | 6 | So named by Col. Baker. |
| 15 (Jubilee do ) | 30 | |
| 16 (Williams do ) | 20 | |
| 17 | 5 | These four are cannel coal. |
| 18 | 3 | |
| 19 | 2 | |
| 20 | 2 | |
| | 132 | |

"The number and thickness of these seams in the above table are as supplied me by Mr. Fernie, who has superintended all the exploratory work that has been done on the seams. Between the most eastern outcrops I examined, and the western ones close to the junction of Marten Creek and the west branch of Michel Creek, is a distance of about two miles along the steep mountain side, to the north of the trail. Within this distance the outcrops were seen of nearly all these seams, either on the ridges or in the sides of the ravines which score the face of the mountain. The few hours I was able to spend on the ground, while not sufficient to enable me to affirm the absolute correctness of the details of the table, were, however, ample to enable me to see that there is in the Crow's Nest pass, between the eastern summit, 4,330 feet above tide, and the valley of Elk River, in British Columbia, an area of not less than 144 square miles, that is destined to be one of the most valuable and most productive coal fields in Canada. A rough calculation would give about 49,952,000 tons per square mile. If one-half of this is available, there are in each square mile 24,976,000 tons. The average elevation of the field is about the same as that of Canmore and Banff, or between 4,000 and 5,000 feet. From

COAL.
Crow's Nest Pass.

Pincher Creek westward to Elk River, the pass presents no difficulties or railway construction. The eastern entrance to the pass in Alberta is 3,800 feet, and where it comes out on the Elk River is ,300 feet; the highest intervening summit being 5,500 feet. A etter route to the Elk River, however, than that of the present rail, would be to follow down Michel Creek, from near the eastern ummit, and thus avoid the western and higher summit, and reach Elk River about ten miles above the mouth of Coal Creek. The listance through the pass from Lee's Lake, Alberta, to the Elk River, is about thirty-seven miles.

"On the 4th of August, after devoting the forenoon to a further examination of the Marten Creek seams, we proceeded through the pass and reached Elk River at 6 p.m. No coal seams were seen till about our miles above the mouth of Coal Creek; here at the mouth of a teep rocky gully, about 200 yards to the right of the trail, a fine seam of coal, 7 feet thick, had been cut into. The section exposed showed in lescending order:

| | | |
|---|---|---|
| Shale | 10 | feet. |
| Hard ferruginous band | 1 | |
| *Coal* | 1·6 | |
| Shale | 7·6 | |
| *Coal* | 7·6 | |

"Cherty conglomerate and massive gritty sandstones are seen both above and below; the dip is about E. 10° N. 15°—20°. A close earch along the mountain side, between here and the water-shed at he head of Coal Creek, would almost certainly disclose the outcrops of nany more of the Marten Creek seams.

"On the 5th of August, we descended the Elk River valley, about even miles, then turning to the left ascended the mountain, a steep limb of 1,500 feet. Here on top of a broken-down cliff of massive andstone, about 50 feet thick, we came to the first of a series of coal eams; the dip being E. 20° N. 35° and the seam 25 to 30 feet thick, vith a shale parting about 2 feet; bar. 24·93. Ascending 130 feet ver shales and brown thick-bedded sandstone forming a similar roken-down cliff of about 50 feet, a second seam of coal was reached, lso 30 feet thick; bar. 24·80. Above this four more seams were xamined:

| | | | |
|---|---|---|---|
| No. 3 | 15 feet, | bar. | 24·57 |
| 4 | 4 do | do | 24·50 |
| 5 | 7 do | do | 24·42 |
| 6 | 30 do | do | 24·35 |

COAL.

Crow's Nest Pass.

"Above No. 6 there are six more seams which were not visited, but the particulars of which given me by Mr. Fernie are as follows:—

| | | | | |
|---|---|---|---|---|
| No. 7 | 10 feet—100 feet from No. 6 | | | |
| 8 | 4 do | 100 | do | 7 |
| 9 | 7 do | 100 | do | 8 |
| 10 | 2 do | 100 | do | 9 |
| 11 | 7 do | 100 | do | 10 |
| 12 | 4 do | 200 | do | 11 |

"The distances are approximate only, they have not been measured.

"The above gives a total thickness of 148 feet of coal against 132 feet in the Marten Creek area on the eastern side of the basin, while in other respects the seams correspond so closely as to make it almost certain that, except where cut out in the valleys, they are continuous beneath the whole intervening area. For much detailed information respecting the Crow's Nest Pass the Annual Report of the Geological Survey, Vol. I., part B., 1885, already cited, and the accompanying map, can be referred to.

"Many of the seams are first-class coking coals, and others are good gas coals, but none of them are anthracites. For analyses of those of the Jubilee and Peter seams, Marten Creek, see Annual Report Geological Survey, Vol. III., part II., pp. 12 s. to 15 s., and for those of the 'cannel' seams, Vol. IV., pp. 7 R. and 8 R.

"On the 6th of August I reached Pincher Creek, and Ottawa on the 14th."

## *Coke.*

Coke.

In this industry there is little new to report. The production, viz., 57,084 tons, valued at $175,592, shows a slight increase over the figures of last year, which were 56,450 tons and $166,298 respectively. This all represents oven-coke and, as in former years, is all the production of the province of Nova Scotia.

Although slight, there has been a steady growth in this industry, as shown by the subjoined figures for past years, obtained from direct returns to this office:—

| | | | |
|---|---|---|---|
| 1886 | 35,396 tons, | valued at | $101,940 |
| 1887 | 40,428 " | " | 135,951 |
| 1888 | 45,373 " | " | 134,181 |
| 1889 | 54,539 " | " | 155,043 |
| 1890 | 56,450 " | " | 166,298 |
| 1891 | 57,084 " | " | 175,592 |

Most of the product represented by the above figures, is used in the iron smelting industry.

Coal.
Coke.

The following table, No. 1, gives, as stated, the imports of oven-coke only, but besides this, the books of the Customs Department show an importation of a small amount of gas coke to the extent of 494 tons, valued at $1,934. This would represent a home consumption of 96,111 tons, apart from the large and unknown quantities of gas coke, resulting as a by-product from the manufacture of illuminating gas throughout the country.

### Coke.

### Table 1.

### Imports of Oven Coke.

| Fiscal Year. | Tons. | Value. |
|---|---|---|
| 1880.. ...... ... ...... .. ... | 3,837 | $19,353 |
| 1881.. .. . ........ ... .... | 5,192 | 26,123 |
| 1882.. .... .......... ..... | 8,157 | 36,670 |
| 1883.. ..... .... .... . . . . | 8,943 | 38,588 |
| 1884..... ..... . .. ... | 11,207 | 44,518 |
| 1885.... .. .... .. ... .. . .. | 11,564 | 41,391 |
| 1886..... .. .... .. .. ...... | 11,858 | 39,756 |
| 1887...................... ..... | 15,110 | 56,222 |
| 1888...... . ... .. .. .. .... | 25,487 | 102,334 |
| 1889...... ... ....... ... .. | 29,557 | 91,902 |
| 1890.. ...................... | 36,564 | 133,344 |
| 1891....... ... ........ | 38,533 | 177,605 |

## COPPER.

### PRODUCTION.

Copper.
Production.

In the matter of the production of this metal in the Dominion there is little new to report. The total amount is made up as under, viz. :—

| | Lbs. |
|---|---|
| Quebec............................ | 5,401,704 |
| Ontario ........................... | 3,527,217 |
| | 8,928,921 |

This amount, taken at 13 cents per pound, which was the average market price for the year, gives a value of $1,160,760. As compared with last year'sfigures, viz., 6,013,671 pounds and $902,050, there is shown a considerable increase, over 46 per cent in the one case and over 28 per cent in the other. The lesser increase in the values is due to a lowering of the average price for the present year of two cents per pound as compared with 1890. The amount of the total, as given above, represents, as in former years, the copper contents of the sul-

COPPER.
Production.

phuretted ores mined in the Eastern Townships of Quebec and of the nickeliferous pyrrhotite of the Sudbury district. The basis of valuation adopted has, as formerly, been the average market price of Lake copper for the year, but whilst it is manifestly best in illustrating the annual realization of the mineral resources of the community to conform thus to a uniform and definite standard of valuation for the metallic products, it must be borne in mind that the actual value to the producer is much below this and dependent upon the state of concentration in which he ships his product, its more or less refractory nature, etc. Thus for the same district different operators may ship very varying grades of material, raw ore, partly concentrated material, or, in some cases, the final metallic product itself, and further, the policy of the individual operators themselves is being constantly changed in this respect.

### DISCOVERY AND DEVELOPMENT.

Discovery and development.

There is little or nothing new to note in this respect, the condition of the industry continuing much the same as last year.

Nova Scotia.

NOVA SCOTIA.—In Nova Scotia work was continued at the Coxheath copper mine, working sulphuretted ores of the metal, the particulars of which are given in the report of the Department of Mines for that province as follows:—

"There is little new to report. A lease to work copper ore at Brierly Brook was applied for by B. G. Gray and J. A. Grant.

"At Coxheath a good deal of work was done. The following will give an idea of the increased value shown by last season's operations at this important mine:—

"The principal mining development at the Coxheath mine during the year has been the sinking of No. 2 shaft to the 320 feet level: at that depth a cross-cut was driven to the north, which cut the 'B' vein at 89 feet from the centre of the shaft, which is about the same distance from the shaft at which this vein was encountered in the 250 feet level; the hanging wall was cut at 141 feet from the shaft. The main ore body in the vein is about 17 feet in width, and the ore averages in quality fully as high grade as in the upper levels; low grade ore is scattered through the remainder of the vein on this level, and the outlook is certainly encouraging for values entirely out of the usual order. The company intend to sink this shaft to the 400 feet level before hoisting ore for market.

"On the New Mountain vein, No. 3 shaft was sunk to its first level at 100 feet, but the vein was not driven upon when operations closed for the season. This vein is of great promise, and several other explorative pits were sunk on it at various points, with good results; and the surface work has located the point of junction of this vein with vein 'B' at a location about 1,700 feet easterly from No. 3 shaft, and 1,300 feet easterly from No. 2 shaft.

COPPER.
Discovery and development.
—Nova Scotia

"A new residence has been erected for the mining captain and staff, and a grade crossing of the Cape Breton Railway been granted by the Dominion authorities.

"On the Argyle area work was confined to additional surface prospect work. In August the mine was visited and reported upon by Geo. Grant Francis, M.E., of London, and Mr. Walter Ingalls of the staff of the 'New York Engineering and Mining Journal;' at that time it was estimated that the ore on the dumps amounted to about 3,000 tons, with a total amount of ore in sight of 42,732 tons; since then the cutting of 'B' vein on the 320 feet level has increased the ore in sight to about 50,000 tons.

"The following is the labour return for 1891:

| | Days. |
|---|---|
| Skilled labour, underground | 5,941 |
| Unskilled " " | 3,867 |
| Skilled " overground | 2,930 |
| Unskilled " " | 4,492 |
| Coal teamster, &c. | 1,249 |
| "Total | 18,679 |

"During the year Mr. Peters visited the mine and perfected plans for concentrating and smelting works. As usual, the work at the mine has been lessened during the winter, but it is hoped that in the spring the construction of the railway will be proceeded with."

Quebec.

QUEBEC.—Development and production has been continued on the same lines as those of last year by the same firms and companies operating the mines at Capelton and Eustis and the Howard and Moulton Hill mines. At the two latter the work was largely of a developmental nature, as it was also at the Harvey Hill mine, near East Broughton, on the Quebec Central Railway. The Excelsior Copper Co., formerly operating this mine, has been reorganized, and is now known as the Leeds Copper Company (Limited). Active operations at this point were suspended late in the year.

New Brunswick.

NEW BRUNSWICK.—In this province, outside of various reports of discovery of copper-bearing veins, about which no further details are to hand, there is nothing to report.

COPPER.

Discovery and development.—Ontario.

ONTARIO.—As stated above, the copper shipped from this province is contained in the matte and other products resulting from the mining of the nickel ore deposits at Sudbury. As thus contained in the matte produced, its spot value is, of course, far below its market value when finally extracted from the same. As, therefore, it does not as yet suit the arrangements of the producers to push the process of extraction in Canada to its final end, the price obtained by them for the copper will be very low. One of the large operators explains to us that its value in this association will not be more than from 4 to 6 cents per pound. Taking them on an average of .5 cents, the spot value of the copper produced in Ontario will be $206,385.

Outside of the productive operations above alluded to, the ordinary amount of sporadic prospecting has been carried on in the province, a specially interesting feature being the start made in the fall to further test the native copper-bearing rocks of the Keeweena formation at Mamainse, about 40 miles north-west of Sault Ste. Marie, on the east shore of Lake Superior. Here a small force of men has been placed with the necessary machinery and provisions for some months' work.

British Columbia.

BRITISH COLUMBIA.—From this province news continues to come in of new discoveries of veins carrying sulphuretted ores of copper, generally intermixed with galena, and of further test works prosecuted upon similar veins found in the last few years, which ores being argentiferous, particulars of the work done are given in the article on "Precious Metals."

Great interest centres in the Kootenay district, in which these veins are mostly located, and whilst the progress made towards establishing the mines upon a complete and profitable basis has not been so rapid as could be wished, still the opening up of the country by the various contemplated lines of railway can hardly be much longer delayed, when the realization may be fairly expected of the bright hopes entertained for the success of this section of the country, and a considerable addition can be expected to Canada's annual production of copper.

Outside of the Kootenay district, some interesting finds are reported in the report of the Minister of Mines for the province, one in the Similkameen district, where three veins of "peacock copper ore" have been located on Friday Creek, a tributary of the Similkameen River. On one claim a tunnel 100 feet long has been driven, at the end of which the vein is reported six feet wide. Over $1,000 have been spent on these three claims during the season. Other discoveries are alluded to situate on Copper Creek, which empties into Kamloops Lake about three miles east of Savona. "Some splendid samples of

Copper.

native copper have been taken from them, but sufficient work has not been done to determine the importance of the deposit."

### MARKETS AND PRICES.

Markets and prices.

The accompanying graphic table "A" shows the fluctuation in the price of this metal, which, compared with last year, shows a continuation in the fall in price which began in the middle of November in that year.

Most of the copper products shipped from Canada go to the United States, a smaller proportion going to Great Britain. With regard to the nickel copper mattes shipped from Sudbury, the difficulties regarding the economical separation of the metals experienced by the refiners by late discoveries and methods adopted seem now to be largely removed; alluding to which fact the *Engineering and Mining Journal* of New York points out that owing to this "and the new and larger markets found for the nickel, the large development of these great Canadian deposits may be expected. The large purchases of nickel mattes by the United States Government for use in making armour plate has been a great advantage to the Canadian producer, even though the price he realized was far below any figure heretofore quoted."

Exports.

In the following tables will be found the figures of exports and imports as returned to the Customs Department:—

COPPER.
TABLE 1.
EXPORTS.

| Year. | Ontario. | Quebec. | Total. |
|---|---|---|---|
| 1885 | | $262,600 | $262,600 |
| 1886 | $16,404 | 232,855 | 249,259 |
| 1887 | 3,416 | 134,550 | 137,966 |
| 1888 | | 257,260 | 257,260 |
| 1889 | | 168,457 | 168,457 |
| 1890 | 2,219 | 396,278 | 398,497 |
| 1891 | 64,719 | 283,385 | 348,104 |

COPPER.
Imports.

### COPPER.

### TABLE 2.

### IMPORTS: PIGS, OLD AND SCRAP.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880 | 31,900 | $ 2,130 |
| 1881 | 9,800 | 1,157 |
| 1882 | 20,200 | 1,984 |
| 1883 | 124,500 | 20,273 |
| 1884 | 40,200 | 3,180 |
| 1885 | 28,600 | 2,016 |
| 1886 | 82,000 | 6,969 |
| 1887 | 40,100 | 2,507 |
| 1888 | 32,300 | 2,322 |
| 1889 | 32,300 | 3,288 |
| 1890 | 112,200 | 11,521 |
| 1891 | 107,800 | 10,452 |

### COPPER.

### TABLE 3.

### IMPORTS: MANUFACTURES.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $123,061 |
| 1881 | 159,163 |
| 1882 | 220,235 |
| 1883 | 247.141 |
| 1884 | 134,534 |
| 1885 | 181,469 |
| 1886 | 219,420 |
| 1887 | 325,365 |
| 1888 | 303,459 |
| 1889 | 402,216 |
| 1890 | 472,668 |
| 1891 | 563,522 |

## GRAPHITE.

### PRODUCTION.

GRAPHITE.
Production.

In last year's report much was said about Canadian graphite and graphite deposits, which it is unnecessary to repeat. With all the numerous known occurrences of the mineral in the Laurentian rocks of the Dominion, but little was done during the year in the way of development and discovery.

**GRAPHITE.** Production.

Altogether there was only a production of 260 tons, valued at $1,560. The production of back years as follows:—

| | | | |
|---|---|---|---|
| 1886 | 500 tons, | valued at | $4,000 |
| 1887 | 300 " | " | 2,400 |
| 1888 | 150 " | " | 1,200 |
| 1889 | 242 " | " | 3,160 |
| 1890 | 175 " | " | 5,200 |
| 1891 | 260 " | " | 1,560 |

From this it will be seen that the industry has never been extensive and is carried on in a very desultory manner.

### DEVELOPMENT AND DISCOVERY.

Discovery and development.—New Brunswick.

NEW BRUNSWICK. The province of New Brunswick was visited by Mr. Brumell and information was obtained regarding development and discovery as follows:—

"*St. John.*—W. F. Best *et al.* of this city are operating on the Hazen property on a continuation eastward of the vein operated until recently by S. S. Mayes. The vein, which is north-east of and near the Cantilever Bridge at St. John, lies at the contact of the crystalline limestone and a trap dyke or mass, and strikes N. 60° E.

"The vein at this working does not show on the surface, but was struck at a depth of 8 feet, where it started in about 2 inches wide. The shaft is now down 50 feet, at which point a level is run 14 feet to the east on the vein, which is 8 or 9 feet wide, divided in the centre by a "horse" of trap about 2 feet wide. The "horse" was found at 30 feet from the surface, and extended to 50 feet, where it disappears; what its lateral dimensions are is not known. The hanging wall of the vein shows a dip of 55° S. The shaft is very free from water, one man with a hand-pump being sufficient to keep it clear; the owners, however, intend putting up steam hoisting gear and pump. The graphite is sometimes associated with pyrite, which, however, breaks away easily, leaving the ore exceptionally pure. Price, f. o. b., $7 per ton.

"*Thorn Brook, N.B.*—On the land of Chas. McAlpin, on the east side of Thorn Brook, is a deposit of earthy graphite. The deposit is about 20 feet wide, striking north-east, and is in altered slates, which are very much jointed and broken up. The graphite is nowhere very solid where exposed, but can readily be dug with pick and shovel. It is said the deposit can be traced for over a mile on the strike of the vein."

GRAPHITE.

Discovery and development. —Quebec.

QUEBEC.—In Quebec new discoveries of graphite are reported from near Quebec city, and from lot 11, range 2, in the township of Lathbury, Ottawa county.

*Walker Mine.*—The Walker mine, in Buckingham township, Ottawa county, which was the chief centre of operations in 1890, has not been regularly worked, owing to financial troubles which obliged the operators to discontinue work on the mill then in process of enlargement.

*Weart Mine.*—Operations were being carried on in the same township near Plumbago Lake, on the old Pew and Weart's lots. Here work is being prosecuted upon what would appear to be a belt in the rusty gneisses of the vicinity, impregnated with graphite. The material mined is thus what is known locally as "disseminated ore," from the mineral occurring disseminated through the rock, as distinguished from the solid form of graphite filling the fissures often found cutting the formation. The works are operated by Mr. Jacob Weart, of Jersey City, N.J., U.S.A., the property comprising N. ½ lot 26 in Range V., lots 25, 26 and 27 in Range VI., and the S. ½ of lots 25 and 26 and lot 28 in Range VII. These lots have long been held for graphite, and some small amount of work was done in 1870, but they have been idle since then until this year, when operations were inaugurated for further development. These comprise the erection of the dwellings, offices and other buildings necessary to carry on operations, including a large mill-building, in which the graphite is separated from the associated rocky matter by the Napenberger process. This is a secret process, dependent, however, in general, upon the method of separating by air currents and the bolting of the crushed and powdered material. Previous to this stage in the treatment, the ore is roasted or burnt in a kiln, very similar to the common lime kiln, and then, passing through a Blake crusher, is finally reduced to powder in a corncracker. The object of the preliminary roasting is to render the rock more friable, a result so far attained, that it is claimed a small corncracker, costing $25, will put through 20 tons per day of the burnt ore.

The mining operations consist mostly of a number of strippings of the rock and shallow parts, together with one open cut about 50 feet long, 25 wide, and 40 deep into the side of a hill. These openings, some seven in all, are spread over an area measuring about 500 by 400 feet, and show the presence of the graphite in the rock exposed. The developments so far made, whilst not extensive enough to demonstrate the width of the belt, nor the length along its strike, for which it is graphitic, prove the existence of a satisfactory extent of ore ground.

GRAPHITE.
Discovery and development.

A large dyke of columnar trap cuts the rocks in the vicinity of the pits. The property is being worked by the owner, chiefly for the purpose of supplying his own factory in the United States with suitable graphite, for use in the manufacture of his patent self-lubricating bushings. These are metal bearings for buggy axles, wind-mills, and for the moving parts of any other machinery. The requisite lubrication is effected by the graphite, which is compressed into spiral grooves on the inside of the bearings. As these uses do not call for very large quantities, the mine will only be operated for short periods, as necessity arises, unless the general demand for the material justifies more extensive and continuous work. The graphite required for the above-mentioned lubricating purposes, must be very pure, fine, and tenacious, in which latter quality, it is stated, the graphite of this mine excels the Ceylon material, which is too soft and friable for the purpose.

## EXPORTS AND IMPORTS.

Exports and Imports.

As shown in tables Nos. 1, 2 and 3 below, there was a total exportation of $72 worth of this mineral, the value of the imports, apart from such highly manufactured articles as lead pencils, amounting to over $41,000.

### GRAPHITE.

### TABLE 1.

### EXPORTS.

| Year. | New Brunswick. | | Ontario. | |
|---|---|---|---|---|
| | Cwts. | Value. | Cwts. | Value. |
| 1886 | 8,142 | $3,586 | ........ | ........ |
| 1887 | 6,294 | 3,017 | ........ | ........ |
| 1888 | 2,700 | 1,080 | ........ | ........ |
| 1889 | 660 | 422 | 22 | $116 |
| 1890 | 400 | 160 | 329 | 1,369 |
| 1891 | 464 | 72 | ........ | ........ |

GRAPHITE.
Imports.

GRAPHITE.

TABLE 2.

IMPORTS OF RAW AND MANUFACTURED PLUMBAGO.

| Fiscal Year. | Plumbago. | Manufactures of Plumbago. |
|---|---|---|
| 1880 | $1,677 | $2,738 |
| 1881 | 2,479 | 1,202 |
| 1882 | 1,028 | 2,181 |
| 1883 | 3,147 | 2,141 |
| 1884 | 2,891 | 2,152 |
| 1885 | 3,729 | 2,805 |
| 1886 | 5,522 | 1,408 |
| 1887 | 4,020 | 2,830 |
| 1888 | 3,802 | 22,604 |
| 1889 | 3,546 | 21,789 |
| 1890 | 3,441 | 26,605 |
| 1891 | 7,217 | 26,201 |

GRAPHITE.

TABLE 3.

IMPORTS OF BLACKLEAD.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $18,055 |
| 1881 | 26,544 |
| 1882 | 25,132 |
| 1883 | 21,151 |
| 1884 | 24,002 |
| 1885 | 24,487 |
| 1886 | 23,211 |
| 1887 | 25,766 |
| 1888 | 7,824 |
| 1889 | 11,852 |
| 1890 | 10,276 |
| 1891 | 8,292 |

## GYPSUM.

GYPSUM.
Production.

The total quantity of gypsum mined and marketed in the Dominion during 1891 was 203,605 tons valued at $206,251, showing a decrease in quantity of 22,904 tons, while the value has increased $12,218. The production is, as in former years, altogether that of the provinces of Ontario, Nova Scotia and New Brunswick, as may be seen on reference to the following table :—

Gypsum.
Production.

### Gypsum.

### Table 1.

### Production by Provinces.

| Provinces. | Tons. | Value. |
|---|---|---|
| Nova Scotia.. .. ............ | 161,934 | $153,955 |
| New Brunswick.............. | 36,011 | 33,996 |
| Ontario ..... .... ...... . .. | 5,660 | 18,300 |
| Totals ....... . .... | 203,605 | $206,251 |

e greater part of the above quantity was shipped in the raw state e United States.

e amount of rock ground and sold as land plaster was 5,400 tons, ıg a net value in the manufactured state of $23,499, and of er of Paris, 61,370 barrels, or 7,671 tons, which would be equiva- o 9,590 tons of crude rock, the value of the finished product $55,039. There is thus shown to have been 14,990 tons of crude manufactured in Canada, or about seven and a half per cent of the output.

sides ground and calcined plaster, a quantity of "Alabastine" and stico" was produced by the Alabastine Company, of Paris, Ont., considerable quantity of rock suitable for the manufacture of a alba" was shipped by the Albert Manufacturing Company, of boro', N.B.

ıe following figures are those of production for the past six years :—

| | | | |
|---|---|---|---|
| 1886 ............ | 162,000 tons, | valued at | $178,742 |
| 1887 ............ | 154,008 | " | 157,277 |
| 1888 ............ | 175,887 | " | 179,393 |
| 1889 ............ | 213,273 | " | 205,108 |
| 1890 ............ | 226,509 | " | 194,033 |
| 1891 ............ | 203,605 | " | 206,251 |

Discovery and development.

ıere is nothing new to report in the industry, the work being ed on by the same firms as in 1890, viz. :—In Ontario: The astine Co., Paris; Thos. Martindale & Co., Cayuga; L. H. son, Caledonia; W. Donaldson & Co., Mount Healy; Grand River um Co., Cayuga. In New Brunswick: The Albert Mfg. Co., boro': McQueen & Stewart, Andover; Jas. Stratton, St. John; . Lyndes, Hopewell Hill.

GYPSUM.
Nova Scotia.

Of those operating in Nova Scotia no list can be given here, as our returns are not received direct from producers, but through the Department of Mines for that province.

The following tables illustrate the exports and imports for the year, and explain themselves:—

Exports.

GYPSUM.

TABLE 2.

EXPORTS OF CRUDE GYPSUM.

| Years | ONTARIO. | | NOVA SCOTIA. | | NEW BRUNSWICK. | | TOTAL. | |
|---|---|---|---|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. | Tons. | Value. | Tons. | Value. |
| 1874 | ..... | ........ | 67,830 | $ 68,164 | ...... | ........ | 67,830 | $ 68,164 |
| 1875 | ..... | ........ | 86,065 | 86,193 | 5,420 | $ 5,420 | 91,485 | 91,61[illegible] |
| 1876 | 120 | $ 180 | 87,720 | 87,590 | 4,925 | 6,616 | 92,765 | 94,38[illegible] |
| 1877 | ..... | ........ | 106,950 | 93,867 | 5,030 | 5,030 | 111,980 | 98,897 |
| 1878 | 489 | 675 | 88,631 | 76,695 | 16,335 | 16,435 | 105,455 | 93,805 |
| 1879 | 579 | 720 | 95,623 | 71,353 | 8,791 | 8,791 | 104,993 | 80,864 |
| 1880 | 875 | 1,240 | 125,685 | 111,833 | 10,375 | 10,987 | 136,955 | 124,060 |
| 1881 | 657 | 1,040 | 110,303 | 100,284 | 10,310 | 15,025 | 121,270 | 116,349 |
| 1882 | 1,249 | 1,946 | 133,426 | 121,070 | 15,597 | 24,581 | 150,272 | 147,597 |
| 1883 | 462 | 837 | 145,448 | 132,834 | 20,242 | 35,557 | 166,152 | 169,228 |
| 1884 | 688 | 1,254 | 107,653 | 100,446 | 21,800 | 32,751 | 130,141 | 134,451 |
| 1885 | 525 | 787 | 81,887 | 77,898 | 15,140 | 27,730 | 97,552 | 106,415 |
| 1886 | 350 | 538 | 118,985 | 114,116 | 23,498 | 40,559 | 142,833 | 155,213 |
| 1887 | 225 | 337 | 112,557 | 106,910 | 19,942 | 39,295 | 132,724 | 146,54[illegible] |
| 1888 | 670 | 910 | 124,818 | 120,429 | 20 | 50 | 125,508 | 121,3[illegible] |
| 1889 | 483 | 692 | 146,204 | 142,850 | 31,495 | 50,862 | 178,182 | 194,40[illegible] |
| 1890 | 205 | 256 | 145,452 | 139,707 | 30,034 | 52,291 | 175,691 | 192,25[illegible] |
| 1891 | 5 | 7 | 143,770 | 140,438 | 27,536 | 41,350 | 171,311 | 181,79[illegible] |

Imports.

GYPSUM.

TABLE 3.

IMPORTS OF CRUDE GYPSUM.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880 | 1,854 | $3,203 |
| 1881 | 1,731 | 3,442 |
| 1882 | 2,132 | 3,761 |
| 1883 | 1,384 | 3,001 |
| 1884 | ........ | 3,416 |
| 1885 | 1,353 | 2,354 |
| 1886 | 1,870 | 2,429 |
| 1887 | 1,557 | 2,492 |
| 1888 | 1,236 | 2,193 |
| 1889 | 1,360 | 2,472 |
| 1890 | 1,050 | 1,928 |
| 1891 | 376 | 640 |

GYPSUM.
Imports.

### GYPSUM.

### TABLE 4.

### IMPORTS OF GROUND GYPSUM.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880 | 1,606,578 | $5,948 |
| 1881 | 1,544,714 | 4,676 |
| 1882 | 759,460 | 2,576 |
| 1883 | 1,017,905 | 2,579 |
| 1884 | 687,432 | 1,936 |
| 1885 | 461,400 | 1,177 |
| 1886 | 224,119 | 675 |
| 1887 | 13,266 | 73 |
| 1888 | 106,068 | 558 |
| 1889 | 74,390 | 372 |
| 1890 | 434,400 | 2,136 |
| 1891 | 36,500 | 215 |

### GYPSUM.

### TABLE 5.

### IMPORTS OF PLASTER OF PARIS.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880 | 667,676 | $2,376 |
| 1881 | 574,006 | 2,864 |
| 1882 | 751,147 | 4,184 |
| 1883 | 1,448,650 | 7,867 |
| 1884 | 782,920 | 5,226 |
| 1885 | 689,521 | 4,809 |
| 1886 | 820,273 | 5,463 |
| 1887 | 594,146 | 4,342 |
| 1888 | 942,338 | 6,662 |
| 1889 | 1,173,996 | 8,513 |
| 1890 | 693,435 | 6,004 |
| 1891 | 1,035,605 | 8,412 |

narket for gypsum in Canada will therefore be, as shown by the g tables, equivalent to about 33,000 tons, as follows :—

Home consumption.

| | | |
|---|---|---|
| Production | 203,605 | tons. |
| Imports, crude gypsum | 376 | " |
| do ground do | 18 | " |
| do plaster of Paris | 518 | " |
| | 204,517 | " |
| Less exports | 171,311 | " |
| | 33,206 | " |

**Iron.**
**Production.**

# IRON.

## PRODUCTION.

The production of iron ore during 1891 shows somewhat of crease compared with that of 1890, the figures being 76,511 tons, $155,380, for the latter, as compared with 68,979 tons, valu $142,005, for the former.

Nova Scotia still continues the main contributor, its produ constituting over seventy-five per cent of the grand total, the being produced in the province of Quebec, with a small quantity British Columbia.

The following table (No. 1) illustrates the course of the iron mi industry in the province of Nova Scotia :—

IRON.

TABLE 1.

NOVA SCOTIA : ANNUAL PRODUCTION OF ORE.

| | Tons. |
|---|---|
| 1876 | 15,274 |
| 1877 | 16,879 |
| 1878 | 36,600 |
| 1879 | 29,889 |
| 1880 | 51,193 |
| 1881 | 39,843 |
| 1882 | 42,135 |
| 1883 | 52,410 |
| 1884 | 54,885 |
| 1885 | 48,129 |
| 1886 | 44,388 |
| 1887 | 43,532 |
| 1888 | 42,611 |
| 1889 | 54,161 |
| 1890 | 49,206 |
| 1891 | 53,649 |

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Scotia

IRON.
Prod

## EXPORTS AND IMPORTS.

IRON.
Exports and Imports.

The exports as shown by the below given table have fallen off very considerably since last year. This is chiefly due to Ontario having shipped none, and some of the Quebec mines having produced less :—

### IRON.
### TABLE 2.
### EXPORTS OF ORE.

| Province. | 1883. | | 1889. | | 1890. | | 1891. | |
|---|---|---|---|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. | Tons. | Value. | Tons. | Value. |
| Ontario. .. ..... | 31,161 | $36,397 | 4,108 | $10,407 | 18,601 | $38,967 | 2,259 | $3,932 |
| Quebec. . ...... | 10 | 380 | ....... | 2,700 | 120 | 1,640 | 191 | 2,683 |
| Nova Scotia .. .. | ....... | ....... | ....... | 100 | ....... | ....... | ....... | ... |
| British Columbia. | 7,300 | 18,400 | 13,335 | 26,680 | 33 | 83 | 359 | 4,958 |
| Totals.... .. | .... | $55,177 | ....... | $39,887 | 18,754 | $40,690 | 2,809 | $11,573 |

As usual no ore has been imported into Canada.

## DISCOVERY AND DEVELOPMENT.

Discovery and development.—Nova Scotia

NOVA SCOTIA.—In Nova Scotia, according to the report of the Department of Mines for the province, " the past season has exhibited a general increased interest in iron smelting, etc. The Londonderry Iron Company have rebuilt one of their furnaces and raised it to a height of seventy-five feet instead of sixty-three, as originally built. Two new kilns for roasting the spathic ores found so abundantly on the company's property, and having a capacity of 100 tons daily, have been erected.

" The New Glasgow Iron, Coal and Railway Company expect to have their furnace in blast next June. Their railway to Bridgeville is about completed, and their development work secures them an abundant supply of good ore. The furnace is sixty-five feet high ; bosh, twenty-five feet six inches ; hearth, nine feet nine inches. Three hot blast stoves. Two blowing engines of 1,000 horse power each. Capacity, 15,000 feet of air per minute. Anticipated yield, 100 tons

IRON.
Discovery and development.
—Nova Scotia

per day. The coke ovens are of the Coppee pattern, and are likely to be the first of their pattern to go into operation in America. Capacity of each oven about six tons, making seventy to eighty tons of coke per day. The coal is all to be crushed and washed before coking, and the ash reduced to about four or five per cent in the coal.

"The Pictou Charcoal Iron Company have located themselves at Bridgeville, on the line of the New Glasgow Company's Railway, and the object of their work may be gathered from the following remarks of Mr. E. J. Sjostedt, Mines Manager:—

"'Our object is to establish a charcoal iron plant here at Bridgeville, and to use the brown ores principally, and to produce a charcoal iron specially adapted for car wheel making, and also for especially strong machine castings. With this object in view we have purchased mining rights of iron ore, limestone and manganese ore, and some six thousand (6,000) acres of hardwood land. The size of our furnace will be eleven feet bosh, and fifty feet in height, and the estimated output for the first few years, five thousand tons per annum.'

"The following memorandum of the operations at Torbrook will be of interest, as marking the commencement of a mining industry in Annapolis county, which promises to be valuable and permanent:—

"'About the beginning of March last active operations were first commenced at Torbrook, Annapolis county, on the bed of red hematite ore discovered there during the previous year. The ore extends along the base of the South Mountain, the strike being about N. 60° E., and has been traced on the surface from Nictaux Falls eastwards to the King's County line, a distance of four miles. The bed has an average thickness of five and a half feet clear ore, and is so tilted up as to dip at an angle varying from seventy to eighty degrees. Both the hanging and foot walls are of a variegated talcose slate, very light in colour and between eighteen to twenty-four inches thick. These walls form a fairly good support for the time being, although slightly soft The country rock is of a dark bluish state, probably of upper Devonian age. A fair sample of the ore yields about sixty per cent metallic iron; silica, nine to ten per cent; lime, four to five per cent; phosphoric acid, 0·3 per cent; sulphur, trace.

"'When decided operations were first entered upon, a shaft was sunk in the ore eighty feet deep, levels driven east and west, and the ore taken out by back stoping. Inside of a month another shaft was sunk, about 350 feet from the first, and the ore mined by underhand stoping. A hoisting engine was soon got into position, and ore raised at the rate of twenty-five tons daily. In the spring a survey was made, and

IRON.

Discovery and development—Nova Scotia

in the summer a railroad constructed from Wilmot station to the mines at Torbrook, a distance of three miles. The track runs alongside of the shafts, the cars being loaded from chutes. Since the construction of this branch line, two new shafts have been put down, and new hoisting gear has replaced the old. At present we have in operation one four-drum hoist, and one single drum hoist. Three small pumps are required to free the mine from water. Steam is supplied to engines and pumps from three boilers. Some slight difficulty has been experienced with faults; but these seem to grow smaller as the depth increases. Some having already disappeared even at the comparatively slight depth of the present workings.

"'All the ore is shipped *via* Windsor Junction to Londonderry. Last month, January, 105 cars were loaded at Torbrook, in all about 1,650 tons.

"The following figures show the production of iron ore during the year:—

| | Tons. |
|---|---|
| Pictou Charcoal Iron Co., Bridgeville, Pictou Co.... | 681 |
| Londonderry Iron Co., Londonderry, Col. Co....... | 46,350 |
| Ore from Springville, Pictou Co................... | 113 |
| " Bridgeville " .................. | 680 |
| " Pugwash, Cumberland Co............... | 214 |
| " Torbrook, Annapolis Co............... | 7,273 |
| New Glasgow I. C. & Ry. Co., Springville, Pictou Co.. | 2,000 |
| Total.......................... | 57,311 |

New Brunswick.

NEW BRUNSWICK.—In New Brunswick a small amount of work has been done in prospecting some of the deposits of ore found there and regarding which Mr. H. P. Brumell during his visit to the province, reports as follows:—

"On the Millstream River, Gloucester county, about one mile east of the Rocky Brook galena vein and on the north side of the river a property has been taken up by W. R. Payne and John Ellis, of Bathurst. On it is a bed of magnetic iron ore interstratified with a highly altered and siliceous argillite. The bed is about twenty-five feet thick, the upper and lower parts being somewhat intermixed with the country rock which strikes E. and W. at an angle of 90°. The ore contains a considerable proportion of iron and copper pyrites, sufficient in the specimens and exposures seen to materially decrease its value.

"Developments consist of a tunnel about twenty-five feet long and a shallow shaft on the bed at the end of the tunnel."

IRON.

Discovery and development—New Brunswick.

Mr. Chalmers, of the Geological Survey corps, calls attention to the various deposits in Kent county, visited by him during the course of his field work, as follows :—

"Bog-iron ore was found on the south side of Buctouche Harbour, Kent county, occupying an area of several acres. Where openings were made in two places, the deposit showed a thickness of from twelve to fifteen inches.

"Just south of Richibucto Head, another deposit of this material was observed, but its extent and thickness was not ascertained. Bog-iron ore was also noticed on the south side of the mouth of Kouchibouguac River by Mr. Wilson, and in a number of other places. No use has yet been made of it."

Quebec.

QUEBEC.—In the province of Quebec, work is still being prosecuted by the Canada Iron Furnace Co., with works at Radnor, and by Messrs. Jno. McDougall & Co., operating at Drummondville. The former employ about 350 and the latter about 125 men. The ores used at these furnaces, for the most part, continue to be those from the bog-iron ore deposits of the vicinity, regarding which the following notes are furnished by Messrs. Giroux and Low of the Geological Survey. According to the former :—

"A pretty good deposit of bog-iron ore was observed in the county of Joliette, along the railway. The Canada Iron Furnace Co., of Radnor, began to work this deposit last July, and their foreman informed me in September, 1891, that he thought he would be able to ship about 200 car loads of the ore to the blast furnace in Radnor by the fall."

Mr. Low writes as follows, of the working of these deposits and others in his district :

"On the north side of the Mekinac River and along a tributary flowing out of Trout Lake, large masses of iron ore have been found in a dark greenish-red gneiss composed chiefly of orthoclase and epidote, but as all the ore yet found contains a large percentage of titanic acid it is practically of no value. Similar ore is found in a large quartz vein, on the west side of the St. Maurice River, about seven miles above the Grandes Piles and near Lake Bouchard, in the Seigniory of Radnor, also in the township of Shawenegan, and about the lakes of the Laurentide Fishing club.

"At Lac Tortue, the Canada Iron Furnace Company have lowered the water of the lake some four feet, and as the lake is very shallow with slightly sloping banks, a large area is laid bare around its edge, and here the bog-iron ore which has been formed in the lake as flat concretions is washed out of the surface mud with hand sieves, while the ore in the deeper part of the lake is raised by a dredge which carries three rows of buckets on an endless belt.

IRON.

Discovery and development —Quebec.

"Apart from Lac Tortue, in all the flat country about Three Rivers on both sides of the St. Lawrence, bog-iron ore is found in patches which vary from three to eighteen inches in thickness. The ore is gathered by the farmers from their lands, and brought in and sold at the furnace. As iron smelting has been in operation about Three Rivers since 1737 the supply of ore in the vicinity is somewhat exhausted, but new supplies of great extent have been found about Gentilly, opposite Three Rivers, and along the Joliette branch of the Canadian Pacific Railway, so that enough ore will be forthcoming to run the new furnace at Radnor which will have a capacity of thirty to fifty tons a day, smelting magnetite from St. Jérôme along with the bog ore.

"On a point about one mile above the mouth of the Mattawin River is a large vein of dark red pegmatite holding masses of magnetite, the only known locality in this region of such ore free from titanic acid."

It is reported of the St. Jérôme mine that it has been operated by capitalists of Albany, N.Y., who had a force of about twenty men at work.

The only other work done in this province was that at Bristol, in Pontiac county. The ore produced at this mine, which is worked by Messrs. Ennis & Co., of Philadelphia, is altogether shipped to the United States. A force of sixty men was employed for some seven months of the year, operations ceasing in July, when it is said a large amount of ore was in stock at the mine. The plant includes two furnaces for roasting the ore for the purpose of removing the sulphur it contains and which varies between fifteen and twenty per cent; this amount is, it is said, reduced to 0·025 per cent by the roasting process.

Ontario.

ONTARIO.—For Ontario, as is shown by the graphic table A, there is no production to report. The exports represent ore mined in Quebec but entered at an Ontario port. In several parts of the province development has been done on various deposits.

Mr. Brumell, during his summer's work, ascertained that "the Ledyard mine on lot 19, con. I. of Belmont, in the county of Peterborough, has lately changed hands, having been sold by Mr. T. D. Ledyard, of Toronto, to the Belmont Bessemer Ore Co., of New York, who were in November, 1891, busily engaged in connecting the property by rail with the Canadian Pacific Railway. On completion of this short piece of railway active operations will be commenced at once, and a large output is confidently looked for."

IRON.

Discovery and development —Ontario.

In the western part of the province in the Thunder Bay district, though no shipments have been made, considerable interest has been taken in the subject of the iron ore deposits. Development work has been in progress near Gunflint Lake, on the boundary, and in Marks township, both south-west of Port Arthur, and also near Finmark on the Canadian Pacific Railway, where the diamond drill was used.

The chief interest has centred, however, on the deposits of the Atic-okan River, where developments have been made by Messrs. Marks & Co., of Port Arthur, in further testing the deposits of magnetite. These were alluded to in last year's report, where the analyses given showed an iron content of from sixty-three to sixty-eight per cent of metallic iron, together with a complete absence of titanium in all the specimens examined, and a sulphur content ranging, where it is specified in the return, of from 0·052 to 0·185.

The work, mentioned in the above report as having been done to prove the property in the way of test pits and surface strippings, has been followed by extensive operations with the diamond drill to explore the deposit in depth. Of the details of the results of this work, however, no information is obtainable.

Mr. W. H. C. Smith, the officer of the survey intrusted with the geological investigation of the district, has not yet concluded his examinations, but gives the subjoined information tentatively :—"The ore in this belt would appear to occur as a series of lenticules lying in vertical attitude which in some cases overlap each other, as shown by one of the diamond drill borings, which was put down at a large angle with the horizon, passing through two such lenses and an intervening rib of rock.

"The stripping done has not been sufficiently extensive to admit an accurate measurement of the size of these lenticules, but they are estimated at between one hundred and two hundred feet long and from thirty-five to fifty feet wide. The depth, so far as determined by diamond drill borings, is not yet made public, but from the position of the ore bodies they are probably of great proportional depth. There is good reason to believe that these isolated ore bodies occur at various depths below the surface.

"The ore is associated with a schistose chlorite rock merging into and probably derived from compact fine-textured greenstones. The rocks flanking the ore bodies to the north have every appearance of being a volcanic series. The valley of the river conceals for the most part the rocks to the south, but they would seem to be more micaceous and to merge into the mica schist of the Coutchiching series.

**IRON.**

Discovery and development —Ontario.

"From his preliminary investigations, Mr. Smith inclines to the opinion that these greenstones mark a definite ferruginous volcanic horizon in the formation probably referable in age to later Huronian times."

The developments made have extended over the belt for a length of about 1,400 feet and a width of about fifty to seventy-five feet.

Negotiations were in progress for the transfer of these properties to Belgian capitalists, and at the close of the year it is reported that a basis of agreement had been arrived at by which the owners give till November, 1892, to test the deposits, and that if these tests result satisfactorily, the mine will be worked upon a royalty with a guaranteed output of 300,000 tons, and a railroad will immediately be built to connect the mine with the Canadian Pacific Railway.

British Columbia.

BRITISH COLUMBIA.—From British Columbia there is little to report. The Puget Sound Iron Company report that no work has been done at their mine at Texada Island, but that operations may be again proceeded with next year.

The only other item with regard to iron is given in the report of the Minister of Mines for the province, as follows :—

"*Glen Iron Co.*—Work on the Glen Iron Mining Company's ground, consisting of 200 acres of land, situated at Cherry Creek Bluff, about twelve miles west of Kamloops, has been prosecuted with commendable activity during the past year, with results which admit of no doubt in regard to its value.

"The veins, four in number, vary from ten to twenty feet in width, and are visible on the surface at distances from three hundred to six hundred feet in length, and possess the great advantage of being situated near the track of the Canadian Pacific Railway. The works are supplied with a chute three hundred feet long, and an aerial wire tramway thirteen hundred feet in length, capable of delivering one hundred tons per ten hours on the cars.

"The ore is pure magnetite of the best quality, particularly adapted to the manufacture of Bessemer steel, and capable of being utilized for the purpose without any intermediate treatment. Seven hundred and fifty tons were shipped last summer to Tacoma, Wash., U.S., and two hundred tons to the Revelstoke Smelting Works for fluxing operations. There is every prospect of heavy shipments being made during the present year. This new mining industry is capable of wide expansion, and promises, in the near future, to assume proportions of great extent, which cannot be overestimated in its influence on the prosperity of the surrounding country."

IRON.

## PIG IRON AND STEEL.

Pig iron production.

Of the 68,979 tons of iron ore mentioned above as produced in Canada during 1891, the returns show that 60,933 tons were smelted, producing 23,891 tons of pig iron, showing an increase over last year's yield of 2,119 tons.

This quantity resulted from the running of four furnaces, operated by the following firms :—

The Londonderry Iron Co., Londonderry, N.S.
The Canada Iron Furnace Co., Radnor, Que.
Jno. McDougall & Co., Drummondville, Que.

The two latter firms use charcoal for fuel in smelting the bog ores as before mentioned and produce a pig iron which is used for the manufacture of railroad car wheels.

The following table, No. 3, gives further details.

### IRON.

### TABLE 3.

### PIG IRON PRODUCTION : CONSUMPTION OF ORE, FUEL, ETC.

| Production and Consumption. | 1890. | | 1891. | |
|---|---|---|---|---|
| | Quantity. | Value. | Quantity. | Value. |
| Pig Iron made ................Tons. | 21,772 | $331,688 | 23,891 | $368,901 |
| Iron ore consumed. . ..... " | 57,304 | 117,880 | 60,933 | 130,955 |
| Fuel consumed. Charcoal .....Bush. | 589,860 | 29,493 | 441,812 | 22,091 |
| Fuel consumed. Coke ........ Tons. | 32,832 | 97,659 | 30,626 | 98,402 |
| Fuel consumed. Coal .......... " | 1,241 | 2,638 | 2,170 | 2,868 |
| Flux consumed ............ ... " | 18,478 | 18,361 | 11,377 | 11,546 |

Table No. 4 below gives the exports of iron and steel goods from Canada, and tables 5, 6 and 7 following give data regarding the country's consumption of similar commodities, whose value is based rather upon the amount of iron they contain than upon their highly manufactured condition.

IRON.

IRON.

TABLE 4.

EXPORTS OF IRON AND STEEL GOODS, THE PRODUCE OF CANADA.

Exports of iron and steel goods.

| Province. | Pig Iron. | Scrap Iron. | Iron Stoves. | Iron Castings | Iron, all other, and Hardware. | Steel and Manufactures of. | Totals. |
|---|---|---|---|---|---|---|---|
| Ontario........ | ...... | $2,463 | $1,244 | $943 | $ 9,460 | $13,326 | $27,436 |
| Quebec........ | $95 | 801 | 308 | 1,218 | 39,530 | 11,087 | 53,039 |
| Nova Scotia... | ...... | 8 | 1,231 | 546 | 20,413 | 41,540 | 63,738 |
| New Brunswick. | ...... | ........ | 235 | ..... .. | 5,367 | ..... ... | 5,602 |
| P. E. Island.... | ...... | ........ | ........ | ........ | 14 | ..... ... | 14 |
| Manitoba . . | ...... | ..... ... | 107 | 45 | 4 | 188 | 344 |
| British Columbia | .. | 1,600 | ..... ... | 15 | 810 | 321 | 2,746 |
| Totals....... | $95 | $4,872 | $3,125 | $2,767 | $75,598 | $66,462 | $152,919 |

IRON.

TABLE 5.

IMPORTS OF PIG IRON, ETC.

Imports of pig iron.

| FISCAL Year. | PIG IRON, CHARCOAL. | | PIG IRON, ALL OTHER. | | PIG IRON, KENTLEDGE, &C. | | TOTAL. | |
|---|---|---|---|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. | Tons. | Value. | Tons. | Value. |
| 1880.. | ..... .. | .... .... | 23,159 | $371,956 | ....... | ......... | 23,159 | $371,956 |
| 1881.. | . . ... | .... ... | 43,630 | 715,997 | ....... | ......... | 43,630 | 715,997 |
| 1882.. | 6,837 | $211,791 | 56,594 | 811,221 | ....... | ......... | 63,431 | 1,023,012 |
| 1883.. | 2,198 | 58,994 | 75,295 | 1,085,755 | ....... | ......... | 77,493 | 1,144,749 |
| 1884.. | 2,893 | 66,602 | 49,291 | 653,708 | ....... | ......... | 52,184 | 720,310 |
| 1885.. | 1,119 | 27,333 | 42,279 | 545,426 | ....... | ......... | 43,398 | 572,759 |
| 1886.. | 3,185 | 60,086 | 42,463 | 528,483 | ....... | ......... | 45,648 | 588,569 |
| 1887.. | 3,919 | 77,420 | 46,295 | 554,388 | ....... | ......... | 50,214 | 631,808 |
| 1888.. | ........ | .. .... | ........ | .......... | 48,973 | $648,012 | 48,973 | 648,012 |
| 1889.. | ........ | .... ... | ........ | .......... | 72,115 | 864,752 | 72,115 | 864,752 |
| 1890.. | ....... | ........ | ........ | . ....... | 87,613 | 1,148,078 | 87,613 | 1,148,078 |
| 1891.. | ........ | ........ | ........ | .......... | 81,317 | 1,085,929 | 81,317 | 1,085,929 |

IRON.

Imports, iron and steel goods.

### IRON.

### TABLE 7.

### IMPORTS: IRON IN SLABS, BLOOMS, LOOPS AND PUDDLED BARS, ETC.

| Fiscal Year. | Cwt. | Value. |
|---|---|---|
| 1880 | 195,572 | $244,601 |
| 1881 | 111,666 | 111,374 |
| 1882 | 203,888 | 222,056 |
| 1883 | 258,639 | 269,818 |
| 1884 | 252,310 | 264,045 |
| 1885 | 312,329 | 287,734 |
| 1886 | 273,316 | 248,461 |
| 1887 | 522,853 | 421,598 |
| 1888 | 110,279 | 93,377 |
| 1889 | 80,383 | 67,181 |
| 1890 | 15,041 | 45,923 |
| 1891 | 41,567 | 38,931 |

### IRON.

### TABLE 8.

### IMPORTS OF IRON AND STEEL GOODS.*

| Fiscal Year. | Value. |
|---|---|
| 1880 | $6,620,260 |
| 1881 | 8,484,175 |
| 1882 | 8,578,685 |
| 1883 | 8,613,739 |
| 1884 | 6,143,870 |
| 1885 | 4,606,193 |
| 1886 | 4,698,882 |
| 1887 | 6,084,704 |
| 1888 | 5,147,111 |
| 1889 | 7,108,052 |
| 1890 | 7,260,845 |
| 1891 | 9,188,502 |

* These figures do not include those of hardware, engines, agricultural implements, or other highly manufactured iron or steel goods.

LEAD.

## LEAD.

Production.

The amount of this metal produced in Canada is small for this year as in the past, our returns only giving 588,665 lbs., which, at the average market price of the metal for the year of 4·35 cents per lb., would have a value of $25,607. Small as this is, however, the figures are five times as great as those of last year.

Regarding discovery and development there is little to say.

LEAD.

Discovery and development.

NEW BRUNSWICK.—In New Brunswick development work was done on veins of argentiferous galena on "Rocky Brook," a branch of the Millstream River, in Gloucester county, and at the Britton mine, near Woodstock.

QUEBEC.—In Quebec the galena mine at the head of Lake Temiscamingue was operated for a few months, but was closed down in March, and the work was suspended. This had been begun in the previous year, and included a thorough outfitting of the mine with plant for mining, concentrating and smelting the ore.

ONTARIO.—In Ontario there is only developmental work to report, and that chiefly on two of the galena-bearing veins traversing the rocks of the Nepigon series of the Black Bay district, near Port Arthur, on Lake Superior.

BRITISH COLUMBIA.—In British Columbia the work done in testing the promising veins carrying argentiferous galena, and copper ores of the new districts in the S.E. corner of the province has resulted of course in the extraction of much lead-bearing material. As this was not shipped, however, it does not enter into the statistics of this year. This stocking of the ore mined has been due to the heavy tariff imposed by the "McKinley Bill" on such ores entering the United States which, with the present condition of communication of these districts, must form for a time the chief market for these ores.

The following tables explain themselves :—

LEAD.

TABLE 1.

IMPORTS OF LEAD.

Imports.

| Fiscal Year. | Old, Scrap and Pig. | | Bars, Blocks, Sheets. | | Total. | |
|---|---|---|---|---|---|---|
| | Cwt. | Value. | Cwt. | Value. | Cwt. | Value. |
| 1880 | ........ | ......... | ........ | ........ | 30,298 | $124,117 |
| 1881 | 16,236 | $ 56,919 | 18,222 | $70,744 | 34,458 | 127,663 |
| 1882 | 36,655 | 120,870 | 10,540 | 35,728 | 47,195 | 156,598 |
| 1883 | 48,780 | 148,759 | 8,591 | 28,785 | 57,371 | 177,544 |
| 1884 | 39,409 | 103,413 | 9,704 | 28,458 | 49,113 | 131,871 |
| 1885 | 36,106 | 87,038 | 9,362 | 24,396 | 45,468 | 111,434 |
| 1886 | 39,945 | 110,947 | 9,793 | 28,948 | 49,738 | 139,895 |
| 1887 | 61,160 | 173,477 | 14,153 | 41,746 | 75,313 | 215,223 |
| 1888 | 68,678 | 196,845 | 14,957 | 45,900 | 83,635 | 242,745 |
| 1889 | 74,223 | 213,132 | 14,173 | 43,482 | 88,396 | 256,614 |
| 1890 | 101,197 | 283,096 | 19,083 | 59,484 | 120,280 | 342,580 |
| 1891 | 86,382 | 243,033 | 15,646 | 48,220 | 102,028 | 291,253 |

LEAD.

Imports.

### LEAD.

### TABLE 2.

### IMPORTS OF LEAD MANUFACTURES.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $15,400 |
| 1881 | 22,629 |
| 1882 | 17,282 |
| 1883 | 25,556 |
| 1884 | 31,361 |
| 1885 | 36,340 |
| 1886 | 33,078 |
| 1887 | 19,140 |
| 1888 | 18,816 |
| 1889 | 16,315 |
| 1890 | 25,600 |
| 1891 | 23,893 |

## MANGANESE.

MANGANESE. Production.

Compared with years previous, the production of manganese for 1891 is only small, as but 255 tons, valued at $6,694 were exported. What the actual production was could not be ascertained, though it is not thought to have been much more than the above amount. For comparison, the following table is presented wherein it will be seen that the decrease in exports, and consequently in production, is very material.

MANGANESE.

Exports.

### MANGANESE.

### TABLE 1.

### EXPORTS OF MANGANESE ORE SINCE 1873.

| Years. | Nova Scotia. | | New Brunswick. | | Total. | |
|---|---|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. | Tons. | Value. |
| 1873 | ..... | ..... | 1,031 | $20,192 | 1,031 | $20,192 |
| 1874 | 6 | $ 12 | 776 | 16,961 | 782 | 16,973 |
| 1875 | ..... | 200 | 194 | 5,314 | 203 | 5,514 |
| 1876 | 21 | 723 | 391 | 7,316 | 412 | 8,039 |
| 1877 | 106 | 3,699 | 785 | 12,210 | 891 | 15,909 |
| 1878 | 106 | 4,889 | 520 | 5,971 | 626 | 10,860 |
| 1879 | 154 | 7,420 | 1,732 | 20,016 | 1,886 | 27,436 |
| 1880 | 79 | 3,090 | 2,100 | 31,707 | 2,179 | 34,797 |
| 1881 | 200 | 18,022 | 1,504 | 22,532 | 1,704 | 40,554 |
| 1882 | 123 | 11,520 | 771 | 14,227 | 894 | 25,747 |
| 1883 | 313 | 8,635 | 1,013 | 16,708 | 1,326 | 25,343 |
| 1884 | 134 | 1,054 | 469 | 9,035 | 603 | 20,089 |
| 1885 | 77 | 5,054 | 1,607 | 29,595 | 1,684 | 34,649 |
| 1886 | (a) 441 | 854 | 1,377 | 27,484 | (a)1,818 | 58,338 |
| 1887 | 578 | 14,240 | 837 | 20,562 | 1,415 | 34,802 |
| 1888 | 87 | 5,759 | 1,094 | 16,073 | 1,181 | 21,832 |
| 1889 | 59 | 3,024 | 1,377 | 26,326 | 1,436 | 29,350 |
| 1890 | 177 | 2,583 | 1,729 | 34,248 | 1,906 | 36,831 |
| 1891 | 22 | 563 | 233 | 6,131 | 255 | 6,694 |

(a) 250 tons from Cornwallis should more correctly be classed under the heading of mineral pigments.

Imports.

Regarding the imports of manganese the following table (2) is thought to be sufficient. No ore is imported.

### MANGANESE.

### TABLE 2.

### IMPORTS: OXIDE OF MANGANESE.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1884 | 3,989 | $ 258 |
| 1885 | 36,778 | 1,794 |
| 1886 | 44,967 | 1,753 |
| 1887 | 59,655 | 2,933 |
| 1888 | 65,014 | 3,022 |
| 1889 | 52,241 | 2,182 |
| 1890 | 67,452 | 3,192 |
| 1891 | 92,087 | 3,743 |

**MANGANESE.**

Discovery and development.

As in years previous, operations were confined to the provinces of Nova Scotia and New Brunswick, wherein are found extensive deposits, and for a description of which the reader is referred to the report of this Division for 1890.

NOVA SCOTIA.—Of operations in Nova Scotia the only available data are the following notes obtained from the report of the Minister of Mines for Nova Scotia for 1891 : -

"Mr. J. W. Stephens took out a few tons from his Teny Cape mine. A few tons were shipped from the Onslow mine ; and Mr. E. T. Moseley, of Sydney, reported having shipped twenty-eight casks of ninety per cent ore from St. Peter's. It is anticipated that a larger out-put will be made during the year 1892."

Regarding the operations in New Brunswick, Mr. Brumell furnishes the following notes as the result of his visits to the districts during the summer.

"*Gowland Mountain*.—Since my visit of the year previous small development operations had been carried on, several shallow pits were sunk and a stripping made in the bed of a small creek on the land of Geo. Harrison. In all of these, very small shows of low grade ore—psilomelane—were found in the granite. No limestone is found on the property, so the probability of large masses of manganese occurring is not good. About twenty tons of rock were taken out on the creek stripping, the rock containing about twenty-five per cent of low grade psilomelane.

"*Markhamville.*—Operations were being carried on by a small force of men who were employed in sorting and milling dump stuff and exploring by means of diamond drill. In all seventy-one holes, averaging 100 feet each, had been sunk—8th September, 1891. In hole No. 68, twelve feet of iron had been bored through, and in No. 69 twenty-five feet of ore ground. Very little ore was being shipped, only sufficient to pay working expenses.

"*Jordan Mountain.*—This property is still idle, and in litigation, after having been bonded to an American company for $40,000. The sale is said to have been prevented through lack of ability to give a clear title. Twenty-five tons of ore now at Sussex awaiting sale or shipment consist principally of manganite with a small proportion of pyrolusite.

"Operations were suspended during the year at Quaco Head and Dawson Settlement, neither of which points were visited owing to lack of time.

## MICA.

Mica.

Production.

During the past few years there has been a steady growth in the production of mica, the output in 1891 having a value of $71,510, an increase over the previous year of $3,436.

The production for the past few years is given below :—

| | |
|---|---|
| 1886 | $29,008 |
| 1887 | 29,816 |
| 1888 | 30,207 |
| 1889 | 28,718 |
| 1890 | 68,074 |
| 1891 | 71,510 |

Of this the greater part was used in electrical construction, though small quantities were sold to various Canadian stove founders, and a certain quantity was ground for lubricants and fireproof paints and cements.

During 1891 there were exported 388,064 pounds of crude and cut mica, valued at $35,252, and $2,338 worth of ground mica, the latter being from Quebec, while of the crude and cut product the exports were as follows :—

| | | | |
|---|---|---|---|
| Ontario | 384,964 | pounds, valued at | $35,077 |
| Quebec | 3,100 | " " | 175 |

During the past few years the exports have been as follows :—

| | |
|---|---|
| 1887 | $ 3,480 |
| 1888 | 23,563 |
| 1889 | 30,597 |
| 1890 | 22,468 |
| 1891 | 37,590 |

## MINERAL PIGMENTS.

Mineral Pigments.

Ochres.

*Ochres.*—The only material produced in Canada during 1891 that might be classed as a mineral pigment was ochre, the production of which was 900 tons, valued at $17,750, showing an increase over last year of 625 tons and $12,625.

The production was altogether that of the province of Quebec, where many extensive deposits of ochre are known to occur.

The production of ochre for the past four years is as follows :—

| | | | |
|---|---|---|---|
| 1887 | 385 | tons, valued at | $ 2,233 |
| 1888 | 397 | " " | 7,900 |
| 1889 | 794 | " " | 15,280 |
| 1890 | 275 | " " | 5,125 |

MINERAL PIGMENTS.

In the summary report of the Geological Survey Department for 1891, Mr. Low speaks thus of the occurrence of ochre in Champlain county, Que:—

Ochres.

"Ochre is a common mineral in this part of the province and is at present worked in two localities—at St. Malo, eight miles from Three Rivers, and at St. Tite junction on the Piles Branch railway.

"At St. Malo the deposit has been proven across twenty-two lots and in width from 100 to 300 yards, with a depth of from one to twenty feet. At St. Tite junction the ochre occurs in two gulleys which join, and run into the St. Maurice; the ore has been proven along both gulleys for nearly half a mile and has everywhere a considerable thickness.

"The St. Maurice Metallic Paint Co. and the Johnson Paint Co. have furnaces for burning the ore at St. Malo, the former grinding the burnt material at Cap Magdeleine, near Three Rivers, the latter at Montreal. At St. Tite junction a furnace and grinding mill are in course of erection by the Radnor Paint Co."

During his summer's work in New Brunswick, Mr. Brumell visited a deposit in Northumberland county, New Brunswick, of which he reports as follows:—

"About one mile above Chaplin's Island, on the north-west branch of the Miramichi River and about 18 miles from Newcastle, occur a number of small veins of a very heavy pure oxide of iron. The deposits, which are small, are scattered throughout the rocks of the district—altered slates—and are rather of the nature interbedded lenticular masses than veins. The rocks strike east and west dipping 65° north. The largest deposit exposed was about three inches wide, and possibly ten or twelve feet long, the depth being unproved.

"The deposits are well developed on the land of Daniel Dennis, which is under a mining license held by John Ferguson, of Newcastle.

"Although the material is remarkably pure there does not seem sufficient to be of great commercial value."

MINERAL PIGMENTS.

Ochres.

The imports of ochre are shown in the following table 1 :

### MINERAL PIGMENTS.

### TABLE 1.

### IMPORTS OF OCHRES.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880 | 571,454 | $ 6,544 |
| 1881 | 677,115 | 8,972 |
| 1882 | 731,526 | 8,202 |
| 1883 | 898,376 | 10,375 |
| 1884 | 533,416 | 6,398 |
| 1885 | 1,119,177 | 12,782 |
| 1886 | 1,100,243 | 12,267 |
| 1887 | 1,460,128 | 17,067 |
| 1888 | 1,725,460 | 17,664 |
| 1889 | 1,342,783 | 12,994 |
| 1890 | 1,394,811 | 14,066 |
| 1891 | 1,528,696 | 20,550 |

Baryta.

*Baryta.*—No baryta was produced during 1891, nor was any imported as may be seen on reference to the following table 2.

### MINERAL PIGMENTS.

### TABLE 2.

### IMPORTS OF BARYTA.

| Fiscal Year. | Cwt. | Value. |
|---|---|---|
| 1880 | 2,230 | $1,525 |
| 1881 | 3,740 | 1,011 |
| 1882 | 497 | 303 |
| 1883 | ........ | 185 |
| 1884 | ........ | 229 |
| 1885 | 7 | 14 |
| 1886 | ........ | 62 |
| 1887 | 379 | 676 |
| 1888 | 236 | 214 |
| 1889 | 1,332 | 987 |
| 1890 | 1,322 | 978 |
| 1891 | ........ | ......... |

MINERAL PIGMENTS.
Litharge.

*Litharge.*—As in previous years, there is no production of this material to report; the only statistics available are those of imports, as follows:—

MINERAL PIGMENTS.

TABLE 3.

IMPORTS OF LITHARGE.

| Fiscal Year. | Cwt. | Value. |
|---|---|---|
| 1880 | 3,041 | $14,334 |
| 1881 | 6,126 | 22,129 |
| 1882 | 4,900 | 16,651 |
| 1883 | 1,532 | 6,173 |
| 1884 | 5,235 | 18,132 |
| 1885 | 4,990 | 16,156 |
| 1886 | 4,928 | 16,003 |
| 1887 | 6,397 | 21,865 |
| 1888 | 7,010 | 23,808 |
| 1889 | 8,089 | 31,082 |
| 1890 | 9,453 | 31,401 |
| 1891 | 7,979 | 27,613 |

MINERAL WATER.

## MINERAL WATER.

Production.

Returns were received by this office which show that during the year there were 427,485 gallons of mineral water placed upon the market, with a value at the springs of $54,268. This shows a very material decrease from last year, amounting to 133,680 gallons, having a value of $11,763. The production for the past three years has been:

| | | |
|---|---|---|
| 1888 | 124,850 gallons | $11,456 |
| 1889 | 424,600 " | 37,360 |
| 1890 | 561,165 " | 66,031 |

The producers making returns for 1891 were:—

| | |
|---|---|
| St. John, N.B. | John R. Smith. |
| Havelock, N.B. | Havelock Mineral Springs Co. |
| Camperdown, Ont | Emily Wensley. |
| Ottawa, Ont. | King Arnoldi. |
| do | Wm. Borthwick. |
| do | F. O. Ring. |
| West Winchester, Ont. | Dr. W. J. Anderson. |
| Brecken, Ont | L. Forrest. |
| Treadwell, Ont. | W. K. Kains. |
| Preston, Ont | Chris. Kress. |

MINERAL WATERS.

| | |
|---|---|
| St. Léon Springs, Que. | St. Léon Mineral Springs Co. |
| St. Hyacinthe, Que | La Cie. d'eau Min. de St. Hyacinthe. |
| Montreal, Que. | J. H. M. Hart. |
| St. Casimir, Que | Jos. Douville fils. |
| Wilmot, N.S. | Wilmot Spa Springs Co. |

A marked feature of the industry is the St. Léon mineral water, of which during the year some 200,000 gallons were shipped. This is, of course, irrespective of the water consumed in the baths and the hotel at the springs. This water is now retailed in all the important cities of the Dominion, and a considerable export trade has been initiated, water having been sent even to South America, where it has been very well received. No statistics of exports are available. The following table illustrates the imports, of which the greater part are from Europe :—

Imports.

MINERAL WATERS.

TABLE 1.

IMPORTS.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $ 15,721 |
| 1881 | 17,913 |
| 1882 | 27,909 |
| 1883 | 28,130 |
| 1884 | 27,879 |
| 1885 | 32,674 |
| 1886 | 22,142 |
| 1887 | 33,314 |
| 1888 | 38,046 |
| 1889 | 30,343 |
| 1890 | 40,802 |
| 1891 | 41,797 |

MISCELLANEOUS.

## MISCELLANEOUS.

Production.

The production of the several materials which are produced to a slight extent only, is given comparatively with the year previous in the following table :—

### MISCELLANEOUS.

### TABLE 1.

### PRODUCTION.

| Product. | 1890. | | 1891. | |
|---|---|---|---|---|
| | Quantity. | Value. | Quantity. | Value. |
| | Tons. | $ | Tons. | $ |
| Felspar | 700 | 3,500 | 685 | 3,425 |
| Fire clay | | | 250 | 750 |
| Moulding sand | 320 | 1,410 | 230 | 1,000 |
| Platinum | | 4,500 | | 10,000 |
| Precious stones | | 700 | | 1,000 |

Felspar.

*Felspar.*—The production of this mineral is largely that of Ontario, a small quantity only being from Ottawa county, Que. The shipments were made to St. John's, Que., where the material was used in the manufacture of porcelain and finer grades of pottery.

Platinum.

*Platinum*.—As in previous years, the production of platinum is altogether that of British Columbia, where it is found in placer workings associated with gold. As may be seen on reference to the following table, the production shows a marked increase over that of previous years, the increase being, however, largely due to the higher price of the metal, which is now increasingly used in dentistry and electricity.

The yearly production since 1887 has been :—

| | |
|---|---|
| 1887 | $ 5,600 |
| 1888 | 6,000 |
| 1889 | 3,500 |
| 1890 | 4,500 |
| 1891 | 10,000 |

MISCELLANEOUS.

Platinum.

The following table shows the imports of this metal in all forms. No exports are reported.

MISCELLANEOUS.

TABLE 2.

IMPORTS OF PLATINUM.

| Fiscal Year. | Value. |
|---|---|
| 1883 | $ 113 |
| 1884 | 576 |
| 1885 | 792 |
| 1886 | 1,154 |
| 1887 | 1,422 |
| 1888 | 13,475 |
| 1889 | 3,167 |
| 1890 | 5,215 |
| 1891 | 4,055 |

Precious stones.

*Precious Stones.*—The production of precious stones given in the first table is that of cut gems and does not include the value of the many rough and polished agates, chlorastrolites, etc., of Lake Superior. The minerals most frequently used as gems are found to a great extent in Ottawa county and consist of the various forms of garnet, tourmaline, asteriated quartz and albite, smaller quantities only of the Nova Scotia agates and jaspers being used.

The value of the various precious stones, including diamonds, imported during the fiscal year ending 30th June, 1891, was $77,988.

*Whiting and Chalk.*—The two following tables give the imports of these two materials and comprise all the available information regarding them:—

MISCELLANEOUS.

TABLE 3.

IMPORTS OF WHITING.

| Fiscal Year. | Cwts. | Value. |
|---|---|---|
| 1880 | 84,115 | $26,092 |
| 1881 | 47,480 | 16,637 |
| 1882 | 36,270 | 16,318 |
| 1883 | 76,012 | 29,334 |
| 1884 | 76,268 | 28,230 |
| 1885 | 67,441 | 23,492 |
| 1886 | 65,124 | 25,533 |
| 1887 | 47,246 | 15,191 |
| 1888 | 76,619 | 20,508 |
| 1889 | 84,658 | 22,735 |
| 1890 | 96,243 | 27,471 |
| 1891 | 84,679 | 27,504 |

MISCELLANEOUS.

Chalk.

### MISCELLANEOUS.

### TABLE 4.

### IMPORTS OF CHALK.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $2,117 |
| 1881 | 2,768 |
| 1882 | 2,882 |
| 1883 | 5,067 |
| 1884 | 2,589 |
| 1885 | 8,003 |
| 1886 | 6,583 |
| 1887 | 5,635 |
| 1888 | 5,865 |
| 1889 | 5,336 |
| 1890 | 7,221 |
| 1891 | 8,193 |

Mercury, tin and zinc.

*Mercury, Tin and Zinc.*—The following tables illustrate the impor of these metals of which none has as yet been produced in Canada:

### MISCELLANEOUS.

### TABLE 5.

### IMPORTS OF MERCURY.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1882 | 2,443 | $ 965 |
| 1883 | 7,410 | 2,991 |
| 1884 | 5,848 | 2,441 |
| 1885 | 14,490 | 4,781 |
| 1886 | 13,316 | 7,142 |
| 1887 | 18,409 | 10,618 |
| 1888 | 27,951 | 14.943 |
| 1889 | 22,931 | 11,844 |
| 1890 | 15,912 | 7.677 |
| 1891 | 29,775 | 20,223 |

MISCELLANEOUS.

Tin.

### MISCELLANEOUS.
### TABLE 6.
### IMPORTS OF TIN AND TINWARE.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $ 281,880 |
| 1881 | 413,924 |
| 1882 | 790,285 |
| 1883 | 1,274,150 |
| 1884 | 1,018,493 |
| 1885 | 1,060,883 |
| 1886 | 1,117,368 |
| 1887 | 1,187,312 |
| 1888 | 1,164,273 |
| 1889 | 1,243,794 |
| 1890 | 1,289,756 |
| 1891 | 1,206,918 |

Zinc.

### MISCELLANEOUS.
### TABLE 7.
### IMPORTS OF ZINC IN BLOCKS, PIGS AND SHEETS.

| Fiscal Year. | Cwts. | Value. |
|---|---|---|
| 1880 | 13,805 | $ 67,881 |
| 1881 | 20,920 | 94,015 |
| 1882 | 15,021 | 76,631 |
| 1883 | 22,765 | 94,799 |
| 1884 | 18,945 | 77,373 |
| 1885 | 20,954 | 70,598 |
| 1886 | 23,146 | 85,599 |
| 1887 | 26,142 | 98,557 |
| 1888 | 16,407 | 65,827 |
| 1889 | 19,782 | 83,935 |
| 1890 | 18,236 | 92,530 |
| 1891 | 17,984 | 105,023 |

### MISCELLANEOUS.
### TABLE 8.
### IMPORTS OF ZINC, MANUFACTURES OF.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $ 8,327 |
| 1881 | 20,178 |
| 1882 | 15,526 |
| 1883 | 22,599 |
| 1884 | 11,952 |
| 1885 | 9,459 |
| 1886 | 7,345 |
| 1887 | 6,561 |
| 1888 | 7,402 |
| 1889 | 7,233 |
| 1890 | 6,472 |
| 1891 | 7,178 |

Miscellaneous.

Zinc.

## MISCELLANEOUS.

### TABLE 9.

### IMPORTS OF SPELTER.

| Fiscal Year. | Cwts. | Value. |
|---|---|---|
| 1880 | 1,073 | $ 5,310 |
| 1881 | 2,904 | 12,276 |
| 1882 | 1,654 | 7,779 |
| 1883 | 1,274 | 5,196 |
| 1884 | 2,239 | 10,417 |
| 1885 | 3,325 | 10,875 |
| 1886 | 5,432 | 18,238 |
| 1887 | 6,908 | 25,007 |
| 1888 | 7,772 | 29,762 |
| 1889 | 8,750 | 37,403 |
| 1890 | 14,570 | 71,122 |
| 1891 | 6,249 | 31,459 |

Natural Gas

Ontario.

## NATURAL GAS.

By H. P. H. Brumell, F.G.S.A.,

*Assistant to the Division.*

During 1891, as in previous years, active operations in search of natural gas were principally confined to Ontario where several large "gushers" were struck. Successful operations during the year were confined to Essex, Welland and Haldimand counties where heavy flows of gas were obtained, while wells sunk at Belleville, Toronto and Kingston afforded very small and short-lived flows. In view of the many failures to obtain gas it cannot be too strongly impressed upon the public that there are certain definite laws governing the production and distribution of gas and that many thousands of dollars are annually spent in futile efforts to obtain gas in ground that is known to be either barren or flooded. Gas is not to be obtained everywhere or anywhere, and before expending many dollars it would be well if investors and promoters of companies should inform themselves as to the district wherein they intend operating. Of course the greater part of the advice possible for the geologist to give is necessarily of a negative character, experiment alone making *absolute certainty* of the productiveness of any gas territory.

### *Welland County.*

Active operations were carried on in this county, notably by the Provincial Natural Gas and Fuel Co., the Erie County Natural Gas Co., and the Mutual Natural Gas Co., several individual wells

NATURAL GAS
Ontario.

ıving also been sunk, among others, those of Ephraim Morningstar ıd Geo. Zimmerman of Humberstone, S. Hopkins of Port Colborne, ıd Murray Kerr of Hamilton, as well as those of local companies at elland and Ridgeway.

The Provincial Company during the year finished thirteen new wells, aking twenty-six in all, as follows :—

| | | Cubic Feet. |
|---|---|---|
| No. | 1 with a daily flow of | 2,050,000 |
| " | 2 " | 375,000 |
| " | 3 " | 600,000 |
| " | 4 " | 2,200,000 |
| " | 5 " | 8,500,000 |
| " | 6 " | 70,000 |
| " | 7 " | 3,000,000 |
| " | 8 " | Abandoned. |
| " | 9 " | 3,500,000 |
| " | 10 " | 4,500,000 |
| " | 11 " | 300,000 |
| " | 12 " | 5,500,000 |
| " | 13 " | 300,000 |
| " | 14 " | Abandoned. |
| " | 15 " | 500,000 |
| " | 16 " | 12,500,000 |
| " | 17 " | 2,500,000 |
| " | 18 " | 2,000,000 |
| " | 19 " | 1,500,000 |
| " | 20 " | 300,000 |
| " | 22 " | 2,600,000 |
| " | 23 " | Abandoned. |
| " | 25 " | 500,000 |
| " | 26 " | 2,750,000 |
| " | 27 " | Abandoned. |
| " | 28 " | Nil. |
| ıaking a total daily flow of | | 56,045,000 |

NATURAL GAS Ontario.

These flows of gas are, with the exception of that in No. 15, all from the white Medina sandstone, according to the following record which is that of No. 1 well:

| Character of Beds. | Thickness. | Formation. |
|---|---|---|
| Surface deposits. | 2 feet. | Drift. |
| Dark gray limestone | 25 " | Corniferous. |
| Drab and gray dolomite, black shales and gypsum | 390 " | Onondaga. |
| Gray dolomite passing into brown | 240 " | Guelph and Niagara. |
| Black shales | 50 " | Niagara. |
| White crystalline dolomite, gray towards bottom | 30 " | Clinton. |
| Red sandstone | 55 " | Medina. |
| Red shale | 10 " | |
| Blue shale | 5 " | |
| White sandstone | 5 " | |
| Blue shale | 20 " | |
| White sandstone | 15 " | Gas horizon. |

In well No. 15 the gas was struck in the Clinton formation at a depth of 625 feet, or five feet above the summit of the Medina.

This company have now three mains supplying the city of Buffalo and carrying the gas across the river from the Canadian side, near the International bridge, to Black Rock on the American side. From the wells these mains are fed by an eight-inch main extending through the entire length of the field, feeders being run from individual wells throughout. As was stated in last year's report, it was the intention of this company to carry well No. 14 to the Trenton limestone to test the gas-producing properties of that formation in this district this was done, without, however, economic result as the limestone was found to be barren.

Natural Gas Ontario.

The record of the well was as follows:—

| Character of Beds. | Thickness. | Formation. |
|---|---|---|
| Surface deposits | 47 feet. | Drift. |
| Drab and gray dolomites and shales | 293 " | Onondaga. |
| Gray and brown dolomites | 240 " | Guelph and Niagara. |
| Black shales | 50 " | Niagara. |
| White and gray dolomites | 30 " | Clinton. |
| Sandstones and shales | 1,000 " | Medina. |
| Limestone and shales | 865 " | Hudson River & Utica. |
| Limestone | 195 " | Trenton. |
| Total depth of well | 2,720 feet. | |

A small flow of gas, 5,000 cubic feet was struck at 750 feet, or 90 feet below the summit of the Medina, at which point the boring would be in the second white sandstone bed. Salt water was struck at 525 feet, and the casing carried to 660 feet, or to the summit of the Medina.

The Erie County Company, an American company, have recently begun active operations and are now supplying gas to a considerable number of consumers in Buffalo. This company purchased several wells, and since their inception have sunk several more. For supplying Buffalo they have two six-inch mains laid across the river to Black Rock. Full particulars regarding this company were not obtained, owing to lack of time and the absence of some of the officials.

NATURAL GAS

Ontario.

## *Haldimand County.*

Two companies have operated successfully in this county, viz.:—The Cayuga Natural Gas Company, Limited, and the Dunnville Natural Gas Company, Limited. The former incorporated with a capital stock of $20,000, drilled one well on lot 19, east side of Ouse Street, in the village of Cayuga. The well attained a depth of 710 feet, in which gas was struck at 563, 603 and 680 feet, the combined flow from these points being 250,000 cubic feet per day. The record of the well is as follows:—

| Character of Beds. | Thickness. | Formation. |
|---|---|---|
| Surface deposits.................. | 23 feet. | Drift. |
| Limestone.................................. | 120 " | Onondaga. |
| Shale bluish.............................. | 132 " | |
| Very hard limestone, with salt water...... | 232 " | Guelph and Niagara. |
| Shale bluish............................ | 41 " | |
| Limestone................................ | 15 " | Clinton. |
| Shale, light blue........................ | 5 " | |
| Sandstone, red.......................... | 35 " | Medina. |
| Shale, red................................ | 62 " | |
| Sandstone, white....................... | 15 " | |
| Shale, red................................ | 30 " | |
| Depth.............. | 710 feet. | |

The mouth of the well is at an elevation of ten feet above the Grand River at Cayuga, and consequently about 600 feet above tide level. Gas is now being supplied to the town, throughout the greater part of which pipes have been laid.

Of the operations of the Dunnville Natural Gas Company less can be said, as owing to lack of time the information was not obtained the record of drilling would, however, be very similar to that at Cayuga or Port Colborne. Three wells were drilled by this company the production of which is now being piped through the town, supplying many shops and private houses.

## *Essex County.*

The only operations in this county in search of natural gas were those undertaken by the Kingsville Natural Gas and Oil Company

NATURAL GAS Ontario.

who, during the year, finished their Nos. 3 and 4 wells. No. 3, drilled on lot 4, con. I., township of Gosfield South, was carried to a depth of 1,015 feet, where it was abandoned on account of salt water having been struck at 1,010 feet. The drilling began beneath a surface covering of eighty-three feet and was finished in limestone. Casing was carried to a depth of 573 feet only. In No. 4, however, the company were more successful, obtaining a daily flow of about 2,500,000 cubic feet of gas. This well is located on lot 7, con. I., Gosfield South, and was carried to a depth of 1,063 feet, in which at from 1,030 to 1,035 feet gas was obtained. Water was encountered at 160 feet and the casing carried to a depth of 531 feet, below which no further flows of water were noted. The company have put in place a new regulator for the town supply and a smaller one on the branch main to the Mettawas Hotel, and are now supplying, as well as shops, private houses and hotels, one saw-mill, grist-mill, woollen-mill, foundry, turning shop and sash and door factory in Kingsville. In Ruthven it is their intention to supply a fruit-evaporating establishment, as well as private houses and shops generally.

Time has not allowed of the examination of the many specimens obtained from the wells of Essex County, but it is expected that the writer will be enabled to make these examinations shortly and make the result known in continuation of the report on gas and oil operations in Ontario now in press.*

### *York County.*

In a well drilled by Messrs. Taylor Bros. on lot 11, con. III., township of York, and near their paper mill (middle mill), a small show of gas was noted in the Trenton limestone at from 700 to 750 feet. The record of the well, kindly furnished by Mr. W. F. Tasker, of Toronto, is as follows:—

| Character of Beds. | Thickness. | Formation. |
|---|---|---|
| Surface deposits........................ | 38 feet. | Drift. |
| Shale...................................... | 440 " | Hudson River and Utica. |
| Limestone, hard........................ | 300 " | Trenton. |
| do soft, with shale.................. | 185 " | |
| do hard................................. | 146 " | |
| "Arkose" beds.......................... | 10 " | |
| Granite.................................... | 8 " | Archæan. |
| Depth of well.......................... | 1,127 feet. | |

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* Annual Report, Geological Survey of Canada, Vol. V., Part Q, 1889-90-91.

NATURAL GAS Ontario.

The well was started at an elevation of about fifty feet above Lake Ontario or 297 feet above mean tide level.

### *Hastings County.*

The Belleville Natural Gas and Oil Company, of Belleville, drilled three wells during the year in search of gas, and in all cases unsuccessfully. The well known as No. 1 was drilled near the Grand Trunk Railway station and reached a depth of 252 feet, the lower 11 feet being in either granite or the "Arkose" beds. No. 2 well, sunk on the bay shore a short distance west of the river, was carried to a depth of 280 feet, and No. 3 on Massagasauga Point to a similar depth. In the latter the boring passed through yellow quartzose sandstone, presumably Potsdam, which rested immediately above the granite in which the boring finished. In No. 2 well a very heavy flow of mineral water was struck, and continues to flow. The water is sulphurous and contains a considerable proportion of sodium chloride.

### *Frontenac County.*

At the Insane Asylum in Kingston, a well was drilled by the Provincial Government, the result being a very small flow of gas. The amount obtained was barely sufficient to burn above the mouth of the casing. The well was shallow, being but 171 feet deep, boring ceasing on the appearance of salt water.

During 1891, the following companies were incorporated under the Joint Stock Companies Act of Ontario, for the purpose of boring for natural gas :—

| Name of Company. | Head Office. | Capital Stock. |
|---|---|---|
| Belleville Natural Gas and Ore Co....... | Belleville ..... | $ 25,000 |
| Canadian Natural Gas Co.... .... .... | Sherkston...... | 100,000 |
| Dunnville Natural Gas Co..... .. ..... | Dunnville.. . . | 20,000 |
| Farmers Natural Gas and Oil Co., of Gosfield . . . ........ .......... .. | Windsor..... . | 100,000 |
| Mimico Natural Gas Co... ..... .... | Toronto...... | 100,000 |
| Mutual Natural Gas Co. of Ontario..... | Welland...... | 20,000 |
| Superior Natural Gas Co. of Ontario..... | Sherkston.... | 100,000 |

Quebec.

QUEBEC.—For many years vague rumours of large flows of gas in the neighbourhood of St. Hyacinthe have been published in the press, and many inquiries have been made of the Geological Survey as to the gas-producing properties of the district. In response to these, Dr. Selwyn, Director of the Geological Survey, as well as the writer visited the district when it was seen that the operations already carried out have not proved it to be gas-bearing to any economic extent.

NATURAL GAS Quebec.

Dr. Selwyn speaks of his investigations in his summary report for 1891, as follows :—

"I proceeded to St. Hyacinthe, and, accompanied by Mr. Beauchemin and Mr. Desaulles, I visited the several sites where gas was reported. The first examined was on the farm of Antoine Laplante, about six miles north of St. Hyacinthe, on the concession St. Amable, two miles south-west of the village of St. Barnabé, and the same distance west of the Richelieu River. Here Laplante had recently, with the aid of a small hand-boring tool, succeeded in reaching the rock at a depth of 90 feet, a continuous, though not large, flow of gas being the result. The material penetrated consisted entirely of clay, with some small stones near the bottom. This boulder clay covers and almost entirely conceals the older rocks, and forms the level surface of the great plain of the Richelieu and Yamaska rivers. A pipe, 1½ inch diameter, has been inserted in the hole, and a continuous, though not powerful, flow of gas was coming from it. On inquiry, I found that, within a radius of 400 yards from this well, there were four places, sites of old wells, where gas is escaping. One of these was sunk 45 years ago, and the gas has been escaping ever since. The others are more or less recent trials for water, and have penetrated to rock through from 85 to 100 feet of clay, and, in all, gas comes from the bottom. In three, an inch and a-half pipe has been inserted, and the escaping gas ignites readily and burns steadily, but the pressure is light. On lot No. 18, parish of St. Hyacinthe, range St. Francis, on the farm of Emile Lorquet, close on the east side of the railway to Farnham, I also found gas escaping in a similar manner from a small pit sunk about two feet into the black soil. Near this, two wells had been sunk, one 150 yards east, 106 feet deep; the other about 500 yards north, 110 feet deep, and in both, I was informed, gas has been encountered at the bottom. The sinking was through clay, like that in the bore-holes on the St. Amable concession, which lies about eleven miles nearly due north, and on the other, or west, side of the Yamaska river."

N.-W. Territories and Manitoba.

NORTH-WEST TERRITORIES AND MANITOBA.—It was reported during the year that gas had been encountered at two points in Manitoba and the Territories. At Dominion City, on the Emerson branch of the Canadian Pacific Railway, gas is said to have been found in a well drilled for water, though of its character or quantity no authentic in-

NATURAL GAS

formation is at hand. Gas was also obtained in two or three wells drilled at Medicine Hat, though to what extent is not known.

British Columbia.

BRITISH COLUMBIA.—In British Columbia one company alone was formed, under the title of the Steveston Natural Gas and Development Co., Vancouver, with a capital stock of $50,000. Of its operations, if any, no data are to hand.

NICKEL.

## NICKEL.

Production.

The improvements in the economic condition of the nickel industry have greatly enhanced the value of Canada's deposits of nickeliferous pyrrhotite, and the benefit to the country accruing from their exploitation.

### PRODUCTION.

These effects are clearly illustrated in the figures of production, given below which show the amount of pure nickel represented in the shipments of nickeliferous material for 1891 to be considerably over three times as great as those of the previous year:—

| | Pounds of pure Nickel in matte, &c. | | |
|---|---|---|---|
| 1890 | 1,435,742, | valued at | $ 933,232 |
| 1891 | 4,626,627 | " | 2,775,976 |

The proportional increase has not been so great in the value as that shown for the amount, the average price for the metal as far as could be ascertained being 60 cents, or 5 cents per pound lower than the price for 1890.

The figures as above calculated represent, of course; the extreme and final value of Canada's nickel production, but the proportion of this value accruing to the various operators is comparatively small being dependent upon the point to which they follow the process of concentration and extraction. This varies at the different mines, the shipments made including mattes of varying degrees of richness and concentration, whilst some small quantities of raw ore even are included, as in the following statement:—

| | | |
|---|---|---|
| Total quantity of ore mined | 85,500 | tons. |
| Quantity of ore treated in production of matte | 72,558 | " |
| Quantity of ore shipped | 175 | " |
| do matte shipped | 10,336 | " |

The shipments of matte vary considerably in their metallic contents, some small lots running as low as 11 per cent of nickel and 5 per cent

**NICKEL.**
Production and values.

copper, and others as high as 32 per cent of nickel and 17 per cent copper. The great bulk of the matte shipped would, however, erage about 22 per cent of nickel and 17 per cent copper.

The price paid for the metals in this condition is said to be, for ckel, from 13 to 21 cents per pound, and for copper, from 4 to 6 cents r pound, so that taking mean values as below we get the following apoximation of the value of the nickeliferous products of the mines the condition in which it leaves them.

| | |
|---|---|
| Nickel contents of matte, &c., 4,626,627 lbs., at say 17c. per pound | $786,526 |
| Copper contents of matte, &c., 3,527,217 lbs., at say 5c. per pound | 173,361 |
| | $959,887 |

There were shipped by rail from this district 10,886 tons of nickel atte, &c., figures which closely agree with those obtained by direct turns. The books of the Customs Department give the value of the ports of nickeliferous material as $667,280.

We are indebted to the Engineering and Mining Journal of New ork for the undermentioned figures of exports of nickel from the competg foreign countries named, which compared with our own figures ustrate the important place Canada had won even last year in the ckel markets of the world:—

| | | Lbs. |
|---|---|---|
| Canada, production of nickel, | 1890 | 1,435,742 |
| New Caledonia* | " | 885,300 |
| Norway | " | 149,872 |
| United States | " | 144,841 |
| Sweden | " | 17,632 |

The value to the Dominion of its nickel deposits has been greatly lded to by the inventions facilitating the extraction of the useful etals from the matte. These improvements are a secret in the pössion of the Orford Copper Company, of Constable Hook, N.J., by hich it is said the nickel is extracted in the form of oxide.

There seems also to be a great likelihood of still further facilities in ie immediate future, as soon as the Mond process arrives at the stage being an industrial success. By this method it is proposed to first ing the nickel in the ore to the state of oxide by roasting and then duce it to the metallic state by heating in a current of water gas.

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*Consular returns of exports.

NICKEL.

The ore containing the reduced nickel is then subjected to the action of carbonic oxide gas at a moderate temperature. The nickel then passes off in combination with the gas, which is then decomposed by subjecting it to a higher temperature in another part of the apparatus, where the nickel is deposited on suitable receptacles.

As it is claimed that any article can be given a coat of the metal equal to that deposited by electrolysis, this process, if commercially successful, will not only be a vast improvement upon the old method of extraction by chemical solution and fractional precipitation of the various metals in the ores, but it may further extend the uses of the metal in plating.

Another bright feature in regard to this industry is to be found in the results of the renewal of the tests of nickel-steel armour plate. These again demonstrated the superiority of this alloy for these purposes, which should assure a growing market for the metal apart from the steadily increasing demand for it in its other and older uses.

## DISCOVERY AND DEVELOPMENT.

Discovery and development —New Brunswick.

NEW BRUNSWICK.—During the season the deposits of pyrrhotite near St. Stephen, N.B., were visited by Mr. H. P. Brumell, who gained the following information :

" Throughout the country to the north of St. Stephen are large areas of diorite, associated with which are many more or less extensive deposits of pyrrhotite. These pyrrhotite masses are almost invariably covered with a deposit of gossan resulting from the oxidation of the pyrrhotite.

" Three properties have been located and small development operations begun on them, viz. :—On the Rogers property by W. F. Todd, *et al.*, on a property to the E. S. E. by Messrs. J. A. Carroll and W. F. Best, and at Milltown by Mr. G. W. Ganong.

" *Todd's Location.*—On Todd's location the development consisted of a shaft 22 feet deep and several trenches which exposed the massive pyrrhotite beneath the gossan. In the shaft no distinct vein characteristics were discoverable, the shaft (12 feet by 12 feet) being completely in ore though occasionally masses of country rock were exposed in the sides. The country rock appears to be a very coarse-grained diorite, being in places much slickensided and showing other evidences of movement. The rock in the vicinity of the ore bodies is highly charged with pyrrhotite, and occasionally with chalcopyrite. On the north-west side of the shaft a rock shows which is found to be a very hard semi-crystalline limestone containing very sparsely scattered

**NICKEL.**
Discovery and development.—New Brunswick.

grains of pyrite or pyrrhotite. What connection this has with the general 'country' rock could not be ascertained.

"Assays made of the ore show about 1·95 per cent of nickel to the ton. One made for W. F. Todd at the Institute of Technology, Boston, afforded 1·92 per cent nickel, and an average specimen from the trench alongside shaft—surface specimens—gave 1·98 per cent nickel. Both in the shaft and trenches, wherever the ore was exposed the copper contained was apparently of too small a percentage to materially affect the value of the ore.

"*Carroll Property.*—This was the first nickel property opened, and is situated about one-half mile or more to the E. S. E. of Todd's property. The owners, Messrs J. A. Carroll and W. F. Best have sunk a shaft about 14 feet deep, in the bottom of which the ore shows strong and clean. The surface indications were not good, consisting mainly of small scattered patches of pyrrhotite in the 'country' rock. The rocks and characters of this property are in every way similar to those at Todd's. An assay of a picked specimen from bottom of shaft afforded W. F. Best of St. John, 2·62 per cent nickel and 7·92 per cent copper. At the time the property was visited, August, 1891, it was stated that the property was under a four months' bond to American parties for $25,000.

"*Ganong's Property.*—On the north bank of the St. Croix River at Milltown, about two miles above St. Stephen, is a body of pyrrhotite showing in a stripping an exposure of ore about twenty-five feet by three feet. Owing to the somewhat inaccessible position of the deposit and the covering of river detritus, little more could be learned about it. The mining right to the property is held by Mr. G. W. Ganong, who says that an assay made of the ore by Mr. F. W. Smith, State Assayer, Boston, gave 1·10 per cent nickel. An assay of ore said to be from this deposit, was made in the Geological Survey laboratory, Report 18 0–1–2, page 16 H, and afforded 0·923 per cent nickel and 0·394 per cent copper.

"*Moore's Lake, Charlotte Co.*—Here a mining license has been granted to E. H. Barter and Geo. J. Clarke of St. Stephen, covering a property on which are several quartz veins. The most southerly of these are two parallel veins a few inches apart which are twelve and seven inches wide respectively, and carry considerable quantities of pyrites. Strike N. 70° E. dip < about 80°.

"In a shaft sunk on these, and about 15 feet deep, the two small veins come together and form a strong and highly mineralized ore body. An assay of this ore gave W. French Smith, of Boston,

$$\left.\begin{array}{l}\text{8 lbs. copper}\ldots\ldots\ldots\ldots\ldots\ldots\ldots\\ \text{12·46 lbs. nickel}\ldots\ldots\ldots\ldots\ldots\ldots\end{array}\right\}\text{to the ton.}$$

NICKEL.
Discovery and development.

"The "country" rock appears to be a highly altered schist heavily charged with pyrite or pyrrhotite.

"The rocks of the entire nickel district consist of coarse and finer grained diabases, those about 400 yards north of Ganong's opening being very coarse grained and holding large masses of plagioclase. Water and timber for mining purposes are both plentiful, and from Carroll's and Todd's properties an easy gradient is available to the mouth of the Dennis stream on the St. Croix where direct shipment can be made by either water or rail."

Quebec.

QUEBEC.—In the province of Quebec there is, so far, nothing of commercial importance to note. Pyrite is a very common mineral in the Laurentian rocks of the area north of the St. Lawrence and Ottawa rivers, and some deposits of pyrrhotite have been found. The gneisses of these districts will often be found to carry quite a large proportion of pyrite, but, so far, these have proved to carry too small a proportion of nickel to be of industrial value. As a further contribution to the evidence on this point, quotation is made below of the results of assays of pyritous specimens from these districts, made by Messrs. Ledoux & Co., of New York, as given in the report of Mr. Obalski, the provincial mining engineer.*

"Magnetic pyrites in gneiss, on lot 1½ West, Range VIII., of Litchfield (Pontiac). This pyrite is rather abundant and is at a short distance from a small hill of diorite.

| | |
|---|---|
| Nickel | 0·28 |
| Cobalt | Traces. |
| Copper | Traces. |
| Iron | 22·24 |
| Sulphur | 9·45 |
| Silver | 0 |
| Insoluble matters | 57·03 |

"Iron pyrites in diorite, township of Clarendon (Pontiac county), lot 24½ N.E. range VII.

| | |
|---|---|
| Nickel | 0·55 |
| Silver | 0 |
| Insoluble matters | 52·41 |

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* Report of the Commissioner of Crown Lands, province of Quebec, 1891.

NICKEL.
Discovery and development.

"Analysis of another specimen of gneiss:
Nickel.............................. Traces.
"Iron pyrites in gneiss, Clarendon Range VII... 27
Nickel.............................. Traces.

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"Magnetic pyrites in diorite. Calumet Island, Range IX., lots 2 and 3.
Nickel.............................. Traces."

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Ontario.

ONTARIO.—In this province the centre of activity is, as in past years, the Sudbury district. Here there were a number of operators working small gangs of men in proving various properties. Of these, the chief were the operations under the management of Mr. A. Merry, jr., on sundry lots in Levack township for capitalists of London, England, having options on the properties. Others making returns to this office are:—The Inez mine, lot 3, concession V., township of Drury, worked by the Drury Nickel Co., employing 75 men. The work done during the year was confined to the erection of buildings and plant preparatory to the inauguration of mining operations proper. Considerable ore had been mined up to the end of the year, said to run over 3 per cent in nickel.

The Algoma Nickel Co. worked a force of 12 men on lot 11, con. V., township of Lorne, and mined some ore, but made no shipments.

A correspondent also writes us that "lot 1, con. II., township of Blezard, is said to be now in process of exploration by Toronto capitalists. The ore from this property is said to be very rich, and is certainly remarkable in appearance, somewhat resembling 15 per cent nickel matte."

Development work was also done on various properties in the vicinity of the Nelson Station, on the Canadian Pacific Railway, in the township of Craig, and at Nickel Mountain, near Wahnapitae Lake.

Mr. A. E. Barlow, of the Departmental Field Staff, furnishes the following notes regarding the district: "During the summer of 1891 very little prospecting was done, on account of the harshness of the Ontario Mining Act. The general condition of the industry is, however, on the whole satisfactory. Had the Customs Smelting Co. been able to get enough capital, the smaller properties would have been developed, but these will receive attention in the near future, and there seems no reason to doubt that the nickel industry has gained a good solid footing.

NICKEL.
Discovery and development.
—Ontario.

"At the Worthington Mine a very white nickel ore occurs in the form of circular or oval patches, surrounded by the more common pyrrhotite or rocky matter. An assay of this made for me by Mr. Thos. L. Walker, M.A., late chemist of the Murray Mine, gave 4·5 per cent of nickel. A complete analysis of this ore was very kindly undertaken by Dr. W. F. Hillebrand, through Prof. F. W. Clark, Chief Chemist of the United States Geological Survey, with the following result:—

| | |
|---|---|
| Iron | 38·36 |
| Nickel | 4·57 |
| Manganese | ·10 |
| Sulphur | 45·11 |
| Sulphuric acid | ·95 |
| Carbonic acid | 1·49* |
| Calcic oxide | 1·91 |
| Magnesia | ·41 |
| Insoluble | 4·80 |
| Water at 100° C | ·55 |
| Water combined | ? |
| Loss and oxygen | ? |

* Calculated on the supposition that all the calcium exists as carbonate.

"Dr. Hillebrand says: 'The sulphide is certainly not pyrrhotite, it is not magnetic, and there is far too much sulphur; neither is it polydymite. There is almost enough sulphur for a mixture Fe$S_2$ with $Ni_3FeS_5$—the polydymite of Sudbury, according to Clark & Catlett. On heating in a closed tube a heavy sublimate of sulphur is formed, which is probably from Fe$S_2$.' Prof. Clark says in his letter: 'It seems to me that the mineral is a mixture, not a definite species. Polydymite may be a constituent of it, but of this there is no proof. your Sudbury minerals deserve an exhaustive study, and the work would be well repaid.'

"At the Worthington Mine, also, another sulphide occurs, which is highly nickeliferous. The richer portions occur in the form of more or less rounded patches of various sizes, and are brighter and more crystalline. The clearest and brightest crystals taken afforded Mr. T. L. Walker, to whom I submitted the samples for assay, 30 per cent of nickel. A complete analysis was made of this sample. The portion used contained both the poorer nickel ore and the supposed mixture of millerite with other sulphides, and also a small amount of rocky matter.

NICKEL.
Discovery and development.
—Ontario.

| | |
|---|---|
| Sulphur | 36·13 |
| Iron | 43·43 |
| Nickel | 17·48 |
| Insoluble | ·50 |
| Moisture, copper and loss | 2·46 |
| | 100·00 |

"*Emmons Nickel Co.*—The discovery of gersdorffite and niccolite on lot 12, con. III., township of Dennison, became known early in 1891, these minerals being recognized in a small specimen brought to the Geological Museum by Mr. Eagleson, of Ottawa, who had obtained the specimen from Mr. D. O'Connor, of Sudbury, the owner of the property.

"Mr. T. L. Walker made an analysis of these minerals together, as they were so intimately mixed in the specimen I had given him that the two minerals could not be separated. The results he gives as follows:—

| | |
|---|---|
| Nickel | 20·87 |
| Cobalt | ·64 |
| Copper | Trace |
| Iron | 2·43 |
| Sulphur | 10·60 |
| Arsenic | 26·04 |
| Silica | 26·70 |
| | 87·28 |

"'I had intended to make a complete analysis, but time was wanting. The other 12·72 per cent is made up of $Al_2O_3$; MgO; CaO and $Na_2O$. Of these, I estimated only $Al_2O_3$, which is 5·43 per cent. Possibly the iron given above was contained in the rock matter and in part of the nickel ore.'

"Mr. Hoffmann has made a complete analysis of the pure gersdorffite. His samples were procured by me from lot 12, con. III., of Dennison."

The Canadian Copper Company have during the year erected plant similar to that installed last year at the Murray mine for concentrating the low grade matte. The description of this process as given in last year's report*, together with further details kindly furnished by Mr. Barlow from his notes, is as follows:—

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*Report of Division of Min. Stat. and Mines, 1890, p. 139 S.

NICKEL.
Discovery and development.
—Ontario.

The process is very similar to that followed in Bessemerising iron. The Manhé converters are cylindrical shaped vessels with convex ends measuring usually about eight feet in length with a diameter of about four feet. They are made of boiler plate and lined with a thick layer of clay mixed with quartz. The latter ingredient is obtained by the Murray Mine from the Bruce Mines, where great quantities of *skimpings* are found, resulting from the jigging of the ore of that mine during its operation in past years. This material consists of the crushed quartzose gangue of the vein cleaned of all but a small proportion of the sulphurets of copper constituting the ore. It carries but a slight amount of felspar. The converter rests with its axis horizontal on a carriage running on a track. It is provided on its upper side with a mouth or throat through which it can be charged. The blast is driven through the charge from two parallel series of small tuyere holes, piercing the lining along either side below and along the length of the vessel. Opposite each of these tuyere holes, corresponding holes are pierced through the tubes which run along the outside of the converter to supply them with blast. These holes are closed with wooden plugs, removable to admit an iron bar, which being poked through them successively during the process of blowing keeps the tuyeres clear and the charge stirred.

A gearing enables the converter to be rotated on the car about its horizontal axis, and the throat having been thus lowered, a charge of low grade matte from the well or forehearth of the cupola is run into it. It is then rotated back till the mouth is again vertical and run around underneath a large hood connected with a stack in another part of the smelter house where it is connected with the blower.

The blast having been continued for about an hour, the converter is again rotated about its longer axis and its contents thus poured into moulds. The slag having been removed, a high grade matte remains, containing from 38 to 40 per cent of nickel, with an equal quantity of copper, which forms the product shipped.

The chief operators and those contributing most largely to the output of the district were, as in past years, the Canadian Copper Co., Messrs. H. H. Vivian & Co., and the Dominion Copper Co. The latter company, however, ceased operations in October, pending a change of ownership, but with the intention of starting up again in the spring. The returns show that from seven to eight hundred men find employment directly in connection with mining and exploring in the district, apart from those whose living depends indirectly upon the industry.

NICKEL.
Discovery and development. —Ontario.

A visit was made to the Schreiber deposits by Dr. Selwyn, the Director of the Survey, in regard to which he speaks as follows :—

"I left Deloraine on the 20th of April, the 22nd was spent at Schreiber in an examination of the cuttings, in the forenoon, four miles west, and in the afternoon, two miles and a half east, and to the openings lately made on a deposit of pyrrhotite precisely like those of Sudbury and occurring on the border of a mass of diabase, associated, as at Sudbury, with schists, breccias and some white granite rock, this latter being well seen near both ends of the first trestle east of Schreiber. The analysis of the samples of the ore that were collected gave only ·003 per cent of nickel, but as in all these deposits the nickel is very unevenly distributed an analysis of a few small samples is of little value as an index of the contents of the whole body. At the date of my visit the snow was still thick in the woods, and I was not able to do more than ascertain that the area over which the pyrrhotite occurred was more than sufficient to constitute a good mine, and was very favourably situated for working. The deposit was, I believe, opened by Messrs. Marks, of Port Arthur, towards the close of 1890. I cannot learn that any work has been done on it since the date of my visit in April last."

During the course of his investigations of the shores of Lake Winnipeg, Mr. Tyrrell, of the Survey staff, made a study of the area of Huronian rocks found on its eastern shore, near the southern end, which he compares with the Sudbury rocks as follows :—

"I also remained for two days at Sudbury for the purpose of comparing the rocks that are there so rich in copper and nickel with those found on the east side of Lake Winnipeg, and it was very gratifying to see the remarkably close similarity between the two sets of rocks."

In view of the importance which this metal is likely to assume in human affairs it would be well for prospectors to direct their attention to the examination of these areas of Huronian rocks, for although the mere presence of these rocks does not assure the existence of nickeliferous deposits, still the chances are good that in many places conditions similar to those accompanying the Sudbury ore deposits will be found to exist with the likelihood of finding similar deposits. These areas, with their extent and position will be found marked on the general geological map of the Dominion issued by the Geological Survey Department.

PETROLEUM.

# PETROLEUM.

By H. P. H. BRUMELL, F.G.S.A.

*Assistant to the Division.*

The year 1891 was one of considerable interest to those operating in oil on account of the discovery of petroleum in Welland and Essex counties in Ontario, and of the further discoveries in the North-west Territories and British Columbia.

## *Lambton County.*

Ontario.

ONTARIO.—In Ontario the most important district is of course that in Lambton county, of which but little can be said beyond the fact that it is still the only district wherein the production is utilized in the manufacture of the various products of petroleum. In the Petrolia and Oil Springs fields there were during the year, according to the *Petrolia Topic*, 5,335 wells producing oil, as follows:—In Petrolia and vicinity in Enniskillen township, 3,525; in Oil Springs, 1,553; in the township of Moore, 70, and in Sarnia township, 187. The usual number of exhausted wells were abandoned during the year and new ones drilled to replace them.

During the past two years there has been a steady decrease in the stocks held by the various tanking companies, as may be seen on reference to the following figures:—

| | | | Bbls. |
|---|---|---|---|
| Stocks on hand, | 1st January, | 1890 ....... | 198,219 |
| " | 1st February | " ....... | 160,621 |
| " | 1st March | " ....... | 144,149 |
| " | 1st April | " ....... | 142,223 |
| " | 1st May | " ....... | 150,665 |
| " | 1st June | " ....... | 165,018 |
| " | 1st July | " ....... | 168,454 |
| " | 1st August | " ....... | 176,318 |
| " | 1st September | " ....... | 167,071 |
| " | 1st October | " ....... | 157,283 |
| " | 1st November | " ....... | 139,449 |
| " | 1st December | " ....... | 123,593 |
| " | 1st January, | 1891 ....... | 96,684 |
| " | 1st February | " ....... | 89,248 |
| " | 1st March | " ....... | 78,638 |
| " | 1st April | " ....... | 64,347 |
| " | 1st May | " ....... | 53,962 |
| " | 1st June | " ....... | 52,458 |
| " | 1st July | " ....... | 61,316 |

PETROLEUM, —Ontario.

This falling off in stocks may, however, very easily be explained by the fact that the consumption of crude oil is yearly increasing, as may be seen on reference to table 4. The supply of crude oil although not as great as that of many years ago, is still amply sufficient for the market and to-day the Enniskillen fields are yearly producing more by reason of the opening up of new territory and the sinking of new wells in the older portions of the field. Several new and successful wells were drilled west of Oil Springs and outside the recognized limit of that field, and explorations in Moore township to the north-west of the Petrolia field are extending the limits of the field in that direction. There is apparently no fear among the oil producers of any immediate famine, although they all recognize the inevitable falling off and final failure of supply that comes to all oil districts.

For any further information regarding this county, the reader is referred to the report of this Division for 1889—part S, vol. IV., Annual Report Geological Survey, 1888-89.

We are again indebted to Mr. James Kerr, of Petrolia, for the following information regarding the prices of crude oil as quoted on the Petrolia Oil Exchange.

PETROLEUM.

TABLE 1.

PETROLEA OIL EXCHANGE, CRUDE PETROLEUM BUSINESS FOR THE YEAR 1891.

| 1891. | Opening Price. | Highest Price. | Lowest Price. | Closing Price. | Average Closing Price. | Sales. (Barrels.) |
|---|---|---|---|---|---|---|
| January | $1 30 | 1 30½ | 1 28½ | 1 30 | 1 30 | 52,655 |
| February | 1 29½ | 1 29½ | 1 27¼ | 1 28 | 1 28½ | 28,649 |
| March | 1 28 | 1 36½ | 1 28 | 1 35 | 1 31¾ | 24,979 |
| April | 1 35½ | 1 38½ | 1 35½ | 1 38½ | 1 37 | 41,173 |
| May | 1 38½ | 1 38¾ | 1 36½ | 1 38 | 1 37½ | 29,375 |
| June | 1 38 | 1 38 | 1 36½ | 1 36½ | 1 37 | 19,811 |
| July | 1 36½ | 1 36½ | 1 32 | 1 34½ | 1 33½ | 31,289 |
| August | 1 34½ | 1 35 | 1 34½ | 1 35 | 1 34¾ | 39,236 |
| September | 1 35 | 1 35½ | ·1 34¾ | 1 35 | 1 35 | 45,095 |
| October | 1 35½ | 1 35½ | 1 34¼ | 1 34¼ | 1 35 | 30,675 |
| November | 1 34¼ | 1 34¼ | 1 26½ | 1 33 | 1 33¼ | 17,531 |
| December | 1 33 | 1 33 | 1 30 | 1 31 | 1 31½ | 16,985 |
| Year 1891 | 1 30 | 1 38¾ | 1 26½ | 1 31 | 1 33¾ | 377,453 |
| " 1890 | 1 01½ | 1 37 | 1 01¼ | 1 30 | 1 18 | 394,924 |
| " 1889 | 1 21 | 1 21 | 80 | 1 01 | 92¾ | 400,932 |
| " 1888 | 75½ | 1 23½ | 71 | 1 23 | 1 02¾ | 516.007 |
| " 1887 | 92 | 92 | 66 | 76 | 78 | 406,203 |

### *Essex County.*

PETROLEUM.
—Ontario.

During 1891 Messrs. Hiram Walker & Sons, of Walkerville, were utilizing, as a lubricant, the crude oil obtained from their No. 2 well, of the Marshfield series. This well was producing daily about four barrels of oil very similar in appearance and gravity to that obtained at Oil Springs. During the fall the well, after being closed down for a short time, was reopened and cleaned out preparatory to having the boring carried to a greater depth.

No use was made during the year of the well at Comber wherein a small flow of oil had been found.

### *Welland County.*

In this county a very interesting discovery was made during the year by the Provincial Natural Gas and Fuel Co., who, in two of their wells, encountered oil. The wells affording the oil are Nos. 20 and 28, located on lots 11 and 12, respectively, of concession III. of Humberstone, where the oil is accompanied in the case of No. 20 by 300,000 cubic ft. of gas per day, that in No. 28 occurring with little or no gas.

The record of these wells is as follows:—

| Character of Beds. | No. 20. | No. 28. | Formation. |
|---|---|---|---|
| Surface deposits | 63 feet. | 72 feet. | Drift. |
| Drab and gray dolomites | 282 " | 273 " | Onondaga. |
| Gray dolomite | 240 " | 240 " | Guelph and Niagara. |
| Black shale | 50 " | 50 " | Niagara. |
| White crystalline dolomite | 30 " | 25 " | Clinton. |
| Red sandstone | 55 " | 55 " | Medina. |
| Red shale | 10 " | 10 " | |
| Blue shale | 5 " | 5 " | |
| White sandstone | 5 " | 5 " | |
| Blue shale | 20 " | 20 " | |
| White sandstone | 22 " | 29 " | |
| Depth | 782 feet. | 784 feet. | |

In well No. 20 salt water was encountered at 540 feet and was cased off, the casing being carried to a depth of 582 feet. Gas was struck in the second white sand at 761 and 764 feet, in both instances being accompanied by oil which had an estimated daily flow of two barrels from each of these depths, or a total flow from the well of four barrels. In No. 28 the oil was found in the same horizon as the foregoing at a depth of 768 feet, or eight feet below the summit of the second sand, and was accompanied by but a small quantity of gas. The oil produced is equal to about two barrels per day. Salt water was cased off at 580 feet.

PETROLEUM. —Ontario.

The oil is of superior quality its gravity being about 45° Baumé; when viewed by transmitted light it is a deep ruby red and by reflected light a dark olive green. As to the limits of the oil territory nothing can as yet be said, as no further explorations for their definition were made.

### *Gaspé County.*

Quebec.

QUEBEC.—As the result of the operations of the Petroleum Oil Trust Co. of Montreal, a non-incorporate body, five wells were sunk in the vicinity of Gaspé Basin, in one of which a small show of light gravity oil was obtained. The oil, which is of about 40° Baumé gravity, is light green in colour and very similar in appearance to the oil found in Welland county, mentioned above. The district was not visited, but on interviewing Mr. James Foley, of Montreal, the president of the company, the following facts were elicited.

In one well, that sunk at Seal Cove, the drilling was continued to a depth of 3,000 feet. Of this the first two feet were through surface deposits, beneath which were encountered 850 feet of bluish shale or slate, followed by 1,298 feet of yellow and white sandstone; fresh water, which flowed over the casing, was found at 30 and 70 feet. During the fall the property and operations were examined by an English expert, though with what result has not been made known.

### *Alberta.*

N. W. Territories.

NORTH-WEST TERRITORIES.—During 1891, Dr. Selwyn, Director of the Geological Survey, visited the district to the south of Pincher Creek to make investigations regarding the reported discovery of oil in that vicinity. In his summary report for 1891, he writes as follows:—

"I found considerable excitement existed in the village (Pincher Creek), in fact, a decided 'boom' in petroleum claims, and that a company had been formed to put down a boring, the site selected for the experiment being on sec. 21, township 3, range 29, some 18 miles south, a little east of Pincher Creek village.

PETROLEUM. —N. W. Territories.

"On Monday, the 20th of July, I proceeded to the locality named, accompanied by several gentlemen interested in the work. The country traversed is fine farming land, a richly grassed undulating prairie well watered by numerous small tributaries of Pincher Creek and the Waterton River, all of which eventually find their way to the Saskatchewan. The site of the proposed boring was on a small flat on the left bank of one of the tributaries of Waterton River. A gang of men were at work erecting a derrick and preparing to put an engine and boiler, already on the ground, in place.

"The evening of the 20th of July and the whole of the following day was devoted to an examination of the rocks that were exposed in the creek both below and above the site selected for boring. They were ordinary varieties of sandstone and sandy shales of the Cretaceous, with irregular dips from 15° to 20°. The last exposure of these rocks up the creek was about three miles and a quarter, then, for about three miles further there were no exposures up to where the creek emerges from a rocky gorge, all along which there are good exposures of hard flinty red, green and gray shales and sandstones, often gritty and quartzose and dipping to south-south-west at 25° to 30°. These are the Cambrian rocks which here form the base of the eastern spurs and ridges of the Rocky Mountains. It was stated that both in this gorge and at several places in pools on the prairie to the eastward, petroleum had been seen, but no one at the boring camp could show me any of these places.

"The whole country for many miles around and up into the entrance of the South Kootenay pass, nine miles to the south, was marked off with the stakes of the oil claims. On inquiry, I was informed that an 'expert' named Baring had been there and had expressed a favourable opinion as to boring where operations were being commenced. I was unable to learn any other reason for fixing the site. The note I made under date 21st July reads: 'There is nothing whatever to indicate the existence of petroleum in this vicinity. It seems highly improbable that it should be found here, though, of course, not impossible.' I subsequently heard that a copious flow of water had been struck and the boring abandoned. The cost of this very absurd and useless operation must have been considerable.

"On the 22nd of July, I left the boring camp and proceeded about eight miles in a southerly direction, gradually approaching the foot of the mountains, till we struck the Kootenay branch of the Waterton River, which here leaves the South Kootenay or Boundary Pass. This stream was then followed up about two miles and a half, where we camped

PETROLEUM. —N. W. Territories.

on the left bank, opposite a depression in the high range which here borders the pass on its southern side, and divides the waters of the Kootenay branch from those of "Cameron Falls" Creek. An ascent of about two miles by a somewhat rough trail mostly over gray and white heavy bedded dolomites, brought us to the summit of this depression. We then descended into the valley of Cameron Falls Creek. This creek takes its rise in a small lake near Camp Akamina of the boundary survey and flows north-east about seven miles to where we struck it, and where it makes an almost right angle bend and flows south-east into Waterton Lake.

Cameron Falls brook is a rapid mountain stream, eight or ten yards wide. After following it up about a mile and a half on the left bank, Mr. Fernie, my guide, remarked that we must be close to where the oil had been found. He had scarcely spoken when, while still in the saddle and on the trail eight or nine feet above the brook, I noticed a powerful odour of petroleum. Descending to the edge of the water and stirring the stones and gravel in the bed of the stream, considerable quantities of oil at once rose to the surface and floated away. Crossing to the right bank it was again seen coming out of the bank, some inches above the then level of the stream. Here, skimming it off the surface of a shallow pool, a wine bottle full was soon collected. This can now be seen in the Geological Survey Museum. Sixty or seventy yards below where the oil was seen, a rocky reef of gray siliceous dolomite crosses the creek and rises into a steep bluff on the left bank; on the right bank, seven or eight feet above the creek, a broad, thickly timbered flat extends for 150 yards to the base of the bordering mountains which culminate six miles to the south-west at the boundary monument, 6,000 feet above sea level.

"No work whatever had been done to test the nature of the oil sources. A comparatively small outlay for some shallow sinking or boring on the flat above described would do this."

British Columbia.

BRITISH COLUMBIA.—Continuing his investigations into British Columbia, Dr. Selwyn proceeds with the account of his work in the same report, as follows:—

### *Kootenay District.*

"On the 23rd of July, we proceeded through the pass, crossing the summit and camping on Akamina Brook, about six miles down the western slope in British Columbia. On the 24th we proceeded down the valley and at about four miles north of the 49th parallel, the trail came down to the level of the brook, and here on the edge of a beaver dam pool there were ledges of hard dark blue shale, dipping

PETROLEUM. —British Columbia.

E. 30° N. < 12°. Lifting layers of this at and below the water a quantity of dark green circular patches of oil rose to the surface, and a precisely similar result followed by stirring up the mud in the bottom of the pool. This place is about fifteen miles in a direct line, west 10° south, from the occurrence on Cameron Falls Creek, the main watershed of the Rocky Mountains and Mounts Kirby, Spence and Yarrell intervening. Oil is said by the Indians (the Stoneys) who frequent this region, to occur at other points, in the Akamina Brook valley, both above and below that recorded. The Akamina joins the Flathead River in Montana, about four miles south of the international boundary. The Beaver Dam oil is of a dark greenish-black, and does not apparently differ much from that of Cameron Falls Creek. Preliminary tests might be made here by sinking a shallow shaft in the shales at the Beaver Dam pool, and by a boring on the sandy and gravelly flat country about two miles and a half north of the boundary line.

"On the 24th of July we camped in Montana, on the left bank of the Flathead River, about two miles above the mouth of the Akamina or Kish-e-ne-nah Creek.

"On the 25th we proceeded up the Flathead Valley, the trail passing for the most part along high terraces of sand, clay and gravel. At 8 a.m. we recrossed the boundary on one of these terraces, and then again descended to the river where we off saddled and waited for the pack train. It arrived at 10.30; and we then ascended again to the high level terrace and turning north crossed a number of ridges and gullies into the valley of Sage Creek, camping on the right bank at about nine miles above its mouth.

"At about a mile and a half higher up, the creek leaves the high mountains which border its upper course in a north-easterly direction up to the main water-hed, some twelve or fourteen miles distant, and here at the edge of the water, on the left bank, I found hard dark flinty shales like those at the Beaver Dam pool on the Akamina, dipping S. 25°-30 W. < 25°. Directly the layers of this rock are raised, the oil rises and spreads over the surface of the water in such abundance that a short time suffices with the aid of a tin cup to collect a bottle full. Here, also a considerable quantity of gas escapes from the cracks and joints in the rock and ignites freely on the application of a match.

"Less than half a mile higher up, on the right bank and on the opposite or west side of the valley, oil was again found issuing from the base of a bank of drift which has here filled the valley and caused the stream to make a sharp bend eastward to the base of the opposite mountain. No rock was exposed here, but every stone in the bed of the creek, especially on being broken or rubbed, gave out a strong odour of petroleum. The oil collected here, a sample of which can be seen in the Museum, differs entirely in appearance from those of Cameron Falls Creek and Akamina or Kish-e-ne-nah Creek.

PETROLEUM. —British Columbia.

" Some of it was of a light lemon yellow, but most of it nearly the colour of pale brandy and with a very powerful petroleum odour.

" The general geological structure, the character of the rocks and the physical aspect of the country in the South Kootenay, the North Kootenay and the Crow's Nest and other passes of the Rocky Mountains have been admirably described by Dr. G. M. Dawson,* and the South Kootenay Pass is also described in his Report on the Geology and Resources of the Forty-ninth Parallel, 1875. For details on the subjects named these works can be referred to. The present is, however, I believe the first recorded instance of the occurrence of petroleum in this region, as well as of its occurrence in Cambrian rocks. Whether the reference of the rocks to this age is correct, is not quite certain; that it is so as regards the somewhat similar siliceous dolomites and quartzose strata of the Kicking Horse Pass has been proved by the discovery of a Cambrian fauna and there seems no reason to doubt that the petroleum-bearing beds of the South Kootenay Pass are of the same age. At present, however, except on the traverses made by Mr. Dawson, little or nothing is known respecting the distribution of the formations in the great block of mountainous country which lies between the 49th and 51st parallels of latitude and the 115th and 117th degrees of longitude, and which comprises the Purcell, Hughes, Macdonald and Galton ranges, and covers an area of about 9,600 square miles, much of it densely wooded and with peaks ranging to eight and nine thousand feet."

## STATISTICS.

Statistics.

*Production.*—During 1891 only ten refineries were working, the Canadian Oil Co. of Hamilton and the Sarnia Oil Co. of Sarnia having suspended operations. Among the refineries operating the only change from last year is that wherein the refinery owned in the past by the Messrs. M. J. Woodward & Co., passed into the hands of Samuel Rogers & Co. of Toronto.

Those operating were: The Imperial Oil Co., S. Rogers & Co., John McDonald; The Petrolea Crude Oil and Tanking Co., The Consumers' Oil Co., McMillan, Kittredge & Co., The Premier Oil Co., and John McMillan, all at Petrolea, and John R. Minhinnick, and W. Spencer & Co., at London.

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*Annual Report, Geological Survey, 1885.

PETROLEUM. —Statistics.

From returns made direct to this office there were 27,860,719 gallons or 796,020 barrels of crude oil consumed. Assuming that the stocks carried into and out of the year by the different refineries were the same, and deducting the decrease in stocks held by the tanking companies of 38,715 barrels, there will be found to have been an approximate production of crude oil of 757,000 barrels, an increase over figures obtained in the same way for last year, of 62,000 barrels. At the average price for crude oil of $1.33 per barrel the value of the year's production would be $1,006,810.

As in previous years, however, the production of crude oil, as shown in the summary table of production, is obtained by computation from the inspection returns of the Inland Revenue Department.

The tanking companies operating as such were: The Petrolea Crude Oil and Tanking Co., The Crown Warehousing Co., and the Producers Tanking Co., all of Petrolea, all of whom kindly furnished returns of their operations during the year. These returns afford the following result:—

| | | |
|---|---|---|
| Stocks, 1st January, 1891........ | 96,683$\frac{33}{35}$ | barrels. |
| Quantity of oil received........... | 505,646$\frac{25}{35}$ | " |
| " " delivered.......... | 544.362$\frac{15}{35}$ | " |
| Stocks, 1st January, 1892......... | 57,968$\frac{8}{35}$ | " |
| Decrease in stocks during year..... | 38,715$\frac{25}{35}$ | " |

Of the operations of the refineries in the manufacture of the various products of petroleum, the following tables compiled from returns made direct to this office give the necessary information.

### PETROLEUM.

### TABLE 2.

### PRODUCTION OF CANADIAN OIL REFINERIES.

| Products. | | 1890. | | 1891. | |
|---|---|---|---|---|---|
| | | Quantity. | Value. | Quantity. | Value. |
| Illuminating oils..... | galls. | 11,129,277 | $1,264,677 | 10,427,040 | $1,170,241 |
| Benzine and naphtha... | " | 636,247 | 37,026 | 603,971 | 36,790 |
| Paraffine oils.......... | " | 446,888 | 64,713 | 622,287 | 75,772 |
| Gas oil............. | " | 4,246,447 | 84,752 | 3,373,720 | 89,267 |
| Lubricating oils and tar. | " | 2,877,388 | 130,349 | 2,500,000 | 101,752 |
| Paraffine wax .... .... | lbs. | 913,730 | 56,903 | 741,611 | 60,687 |
| Totals.................. | | ............ | $1,638,420 | ............ | $1,534,509 |

PETROLEUM.
—Statistics.

PETROLEUM.

TABLE 3.

CONSUMPTION OF CRUDE OIL AND CHEMICALS.

| Articles. | 1889. | 1890. | 1891. |
|---|---|---|---|
| Crude petroleum........galls. | 25,066,275 | 28,267,746 | 27,860,719 |
| Sulphuric acid..... .. .. lbs. | 3,638,704 | 4,284,826 | 4,213,984 |
| Soda.................... " | 380,487 | 336,758 | 319,736 |
| Litharge.... ............ " | 477,969 | 443,922 | 394,715 |
| Sulphur..... ..... ...... " | 76,325 | 85,729 | 54,032 |

The data for the compilation of the following figures, and of tables 4 and 5, are taken from the books of the Inland Revenue Department, and show the number of packages of Canadian oil inspected during the calendar year 1891, as well as the total quantity of refined oil, imported and domestic oil, inspected during the fiscal years from 1881 to 1891 inclusive.

During 1891 the packages of Canadian oil inspected were:—

| | |
|---|---|
| 234,824............... | at 10 cents inspection fee. |
| 9............... | at 5 " |
| 40,553............... | at 2½ " |

Assuming that these packages contain 42, 10 and 5 gallons respectively there will be found to have been an inspection of

| | | | | |
|---|---|---|---|---|
| 9,862,608 | gallons | in packages | of 42 | gallons each |
| 90 | " | " | 10 | " |
| 202,765 | " | " | 5 | " |

or a total inspection of 10,065,463 gallons. This quantity computed at an average percentage of 38 would be equivalent to a consumption of crude oil of 26,435,430 gallons or 755,298 barrels, which at the average price of $1.33 would have a value of $1,004,546.

PETROLEUM —Statistics.

The following table, computed in a manner similar to the above, shows the quantity of crude oil used each fiscal year since 1881.

PETROLEUM.

TABLE 4.

CANADIAN OILS AND NAPHTHA INSPECTED AND CORRESPONDING QUANTITIES OF CRUDE OIL.

| Fiscal Year. | Refined Oils Inspected. | Crude Equivalent Calculated. | Ratio of Crude to Refined. |
|---|---|---|---|
| | Galls. | Galls. | |
| 1881 | 6,406,783 | 12,813,566 | 100 : 50 |
| 1882 | 5,910,787 | 13,134,993 | 100 : 45 |
| 1883 | 6,970,550 | 15,490,111 | 100 : 45 |
| 1884 | 7,656,011 | 19,140.027 | 100 : 40 |
| 1885 | 7,661,617 | 19,154,042 | 100 : 40 |
| 1886 | 8,149,472 | 21,445,979 | 100 : 38 |
| 1887 | 8,243,962 | 21,694,637 | 100 : 38 |
| 1888 | 9,545,895 | 25,120,776 | 100 : 38 |
| 1889 | 9,462,834 | 24,902,195 | 100 : 38 |
| 1890 | 10,121,210 | 26,634,763 | 100 : 38 |
| 1891 | 10,270,107 | 27,026,597 | 100 : 38 |

The following table (5) shows the total amount of illuminating oil, both domestic and imported, inspected during the fiscal years from 1881 to 1891, inclusive, and illustrates the market for that product in Canada :—

PETROLEUM.

TABLE 5.

TOTAL AMOUNT OF OIL, IMPORTED AND CANADIAN, INSPECTED.

| Fiscal Year. | Imported. | Canadian. | Total. |
|---|---|---|---|
| | Galls. | Galls. | Galls. |
| 1881 | 476,784 | 6,406,783 | 6,883,567 |
| 1882 | 1,351,412 | 5,910,747 | 7,262,159 |
| 1883 | 1,190,828 | 6,970,550 | 8,161,378 |
| 1884 | 1,142,575 | 7,656,011 | 8,798,586 |
| 1885 | 1,278,115 | 7,661,617 | 8,939,732 |
| 1886 | 1,327,616 | 8,149,472 | 9,477,088 |
| 1887 | 1,665,604 | 8,243,962 | 9,909,566 |
| 1888 | 1,821,342 | 9,545,895 | 11,367,237 |
| 1889 | 1,767,812 | 9,462,834 | 11,230,646 |
| 1890 | 2,020,742 | 10,121,210 | 12,141,952 |
| 1891 | 2,022,002 | 10,270,107 | 12,292,109 |

ie following tables of exports and imports of oil are compiled from mation obtained from the Customs Department and explain thems :—

PETROLEUM —Statistics.

### PETROLEUM.

### TABLE 6.

XPORTS OF CANADIAN CRUDE AND REFINED PETROLEUM FROM 1873 TO 1891.

| Calendar Year. | Gallons. | Value. |
|---|---|---|
| 1873 | 5,869,579 | $1,287,576 |
| 1874 | 28,946 | 2,509 |
| 1875 | 11,836 | 2,214 |
| 1876 | 2,533,772 | 583,550 |
| 1877 | 1,431,883 | 323,013 |
| 1878 | 609,171 | 85,571 |
| 1879 | 235,171 | 17,032 |
| 1880 | 3,085 | 751 |
| 1881 | 501 | 99 |
| 1882 | 1,119 | 286 |
| 1883 | 13,283 | 710 |
| 1884 | 1,098,090 | 30,168 |
| 1885 | 337,967 | 10,562 |
| 1886 | 241,716 | 9,855 |
| 1887 | 473,559 | 13,831 |
| 1888 | 196,602 | 74,542 |
| 1889 | 235,855 | 10,777 |
| 1890 | 420,492 | 18,154 |
| 1891 | 447,355 | 18,575 |

### PETROLEUM.

### TABLE 7.

IMPORTS OF CRUDE AND REFINED PETROLEUM.

| Fiscal Year. | Gallons. | Value. |
|---|---|---|
| 1880 | 687,641 | $131,359 |
| 1881 | 1,437,475 | 262,168 |
| 1882 | 3,007,702 | 398,031 |
| 1883 | 3,086,316 | 358,546 |
| 1884 | 3,160,282 | 380,082 |
| 1885 | 3,767,441 | 415,195 |
| 1886 | 3,819,146 | 421,836 |
| 1887 | 4,290,003 | 467,003 |
| 1888 | 4,523,056 | 408,025 |
| 1889 | 4,650,274 | 484,462 |
| 1890 | 5,075,650 | 515,852 |
| 1891 | 5,071,386 | 498,330 |

PETROLEUM —Statistics.

Subtracting the quantities of imported oils inspected (Table 5) from those shown in Table 7, there will be found to have been an annual importation of oil, crude and other than illuminating, as shown in the following Table 8 :—

### PETROLEUM.

### TABLE 8.

### IMPORTS OF CRUDE AND MANUFACTURED OILS OTHER THAN ILLUMINATING.

| Fiscal Year. | Gallons. |
|---|---|
| 1881 | 960,691 |
| 1882 | 1,656,290 |
| 1883 | 1,895,488 |
| 1884 | 2,017,707 |
| 1885 | 2,489,326 |
| 1886 | 2,491,530 |
| 1887 | 2,624,399 |
| 1888 | 2,701,714 |
| 1889 | 2,882,462 |
| 1890 | 3,054,908 |
| 1891 | 3,049,384 |

The imports of paraffine wax and paraffine wax candles are shown in the following tables 9 and 10 :—

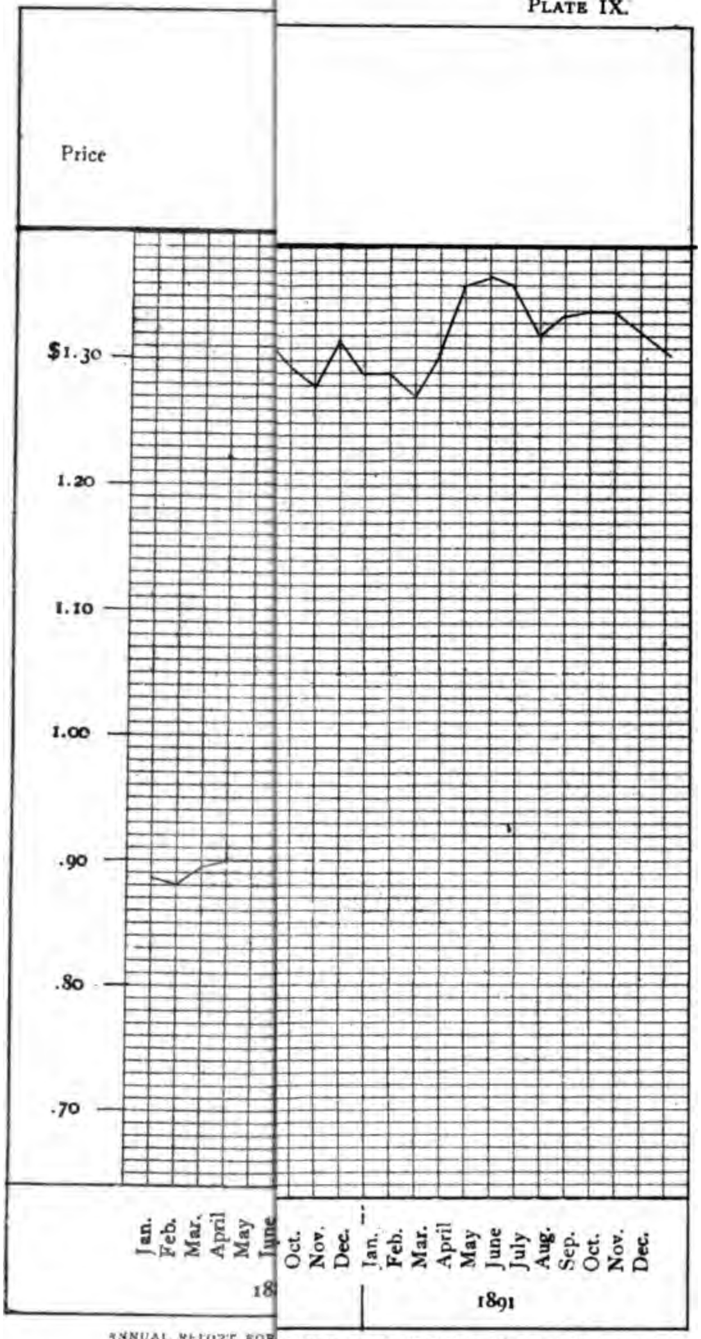
### PETROLEUM.

### TABLE 9.

### IMPORTS OF PARAFFINE WAX.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1883 | 43,716 | $ 5,166 |
| 1884 | 39,010 | 6,079 |
| 1885 | 59,967 | 8,123 |
| 1886 | 62,035 | 7,953 |
| 1887 | 61,132 | 6,796 |
| 1888 | 53,862 | 4,930 |
| 1889 | 63,229 | 5,250 |
| 1890 | 239,229 | 15,844 |
| 1891 | 753,854 | 50,275 |

PLATE IX.



ANNUAL REPORT FOR

NNUAL REPORT, 1891-92, Vol. VI.

PETROLEUM —Statistics.

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PETROLEUM.

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| 1884 | 39,010 | 6,079 |
| 1885 | 59,967 | 8,123 |
| 1886 | 62,035 | 7,953 |
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| 1890 | 239,229 | 15,844 |
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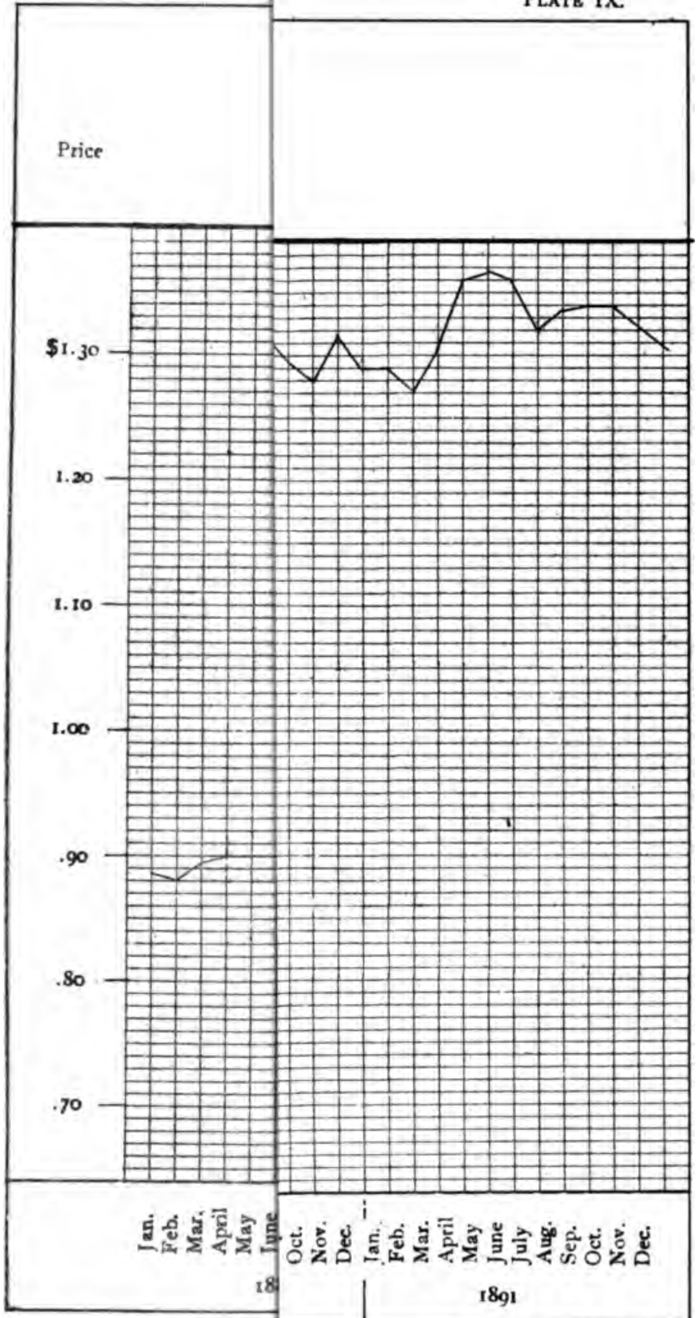
PLATE IX.



ANNUAL REPORT FOR

ANNUAL REPORT, 1891-92, Vol. VI.

PETROLEUM —Statistics.

PETROLEUM.

TABLE 10.

IMPORTS OF PARAFFINE WAX CANDLES.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880 | 10,445 | $2,269 |
| 1881 | 7,494 | 1,683 |
| 1882 | 5,818 | 1,428 |
| 1883 | 7,149 | 1,734 |
| 1884 | 8,755 | 2,229 |
| 1885 | 9,247 | 2,449 |
| 1886 | 12,242 | 2,587 |
| 1887 | 21,364 | 3,611 |
| 1888 | 22,054 | 2,829 |
| 1889 | 8,038 | 1,337 |
| 1890 | 7,233 | 1,186 |
| 1891 | 10,598 | 2,116 |

## PHOSPHATE.

PHOSPHATE —Production.

During 1891 there were 23,588 tons of phosphate (apatite) marketed, having a spot value of $241,603, the production being that of the provinces of Ontario and Quebec, as follows:—

Ontario, 2,344 tons, valued at..........$ 35,187
Quebec, 20,244 " " .......... 206,416

The production for this year shows a marked falling off in comparison with 1890, the decrease in quantity being 8,165 tons, and in value $119,442. For the past six years the production has been as follows:—

1886—20,495 tons, valued at...........$304,338
1887—23,690 " " ........... 319,815
1888—22,485 " " ........... 242,285
1889—30,988 " " ........... 316,662
1890—31,753 " " ........... 361,045
1891—23,588 " " ........... 241,603

This falling off in production is almost entirely due to the decrease in prices, caused by the entrance into the market of the cheaper and lower grade phosphatic rock of Florida, of which large quantities have been shipped at a comparatively low cost.

The following Table 1 and graphic table A gives all the available information regarding exports of phosphate, the greater part of which goes to Great Britain.

PHOSPHATE
—Statistics.

### PHOSPHATE.
### TABLE 1.
### EXPORTS OF PHOSPHATE.

| Year. | Ontario. | | Quebec. | |
|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. |
| 1878 | 824 | $ 12,278 | 9,919 | $195,831 |
| 1879 | 1,842 | 20,565 | 6,604 | 101,470 |
| 1880 | 1,387 | 14,422 | 11,673 | 175,664 |
| 1881 | 2,471 | 36,117 | 9,497 | 182,339 |
| 1882 | 568 | 6,338 | 16,585 | 302,019 |
| 1883 | 50 | 500 | 19,666 | 427,168 |
| 1884 | 763 | 8,890 | 20,946 | 415,350 |
| 1885 | 434 | 5,962 | 28,535 | 490,331 |
| 1886 | 644 | 5,816 | 19,796 | 337,191 |
| 1887 | 705 | 8,277 | 22,447 | 424,940 |
| 1888 | 2,643 | 30,247 | 16,133 | 268,362 |
| 1889 | 3,547 | 38,833 | 26,440 | 355,935 |
| 1890 | 1,866 | 21,329 | 26,591 | 478,040 |
| 1891 | 1,551 | 16,646 | 15,720 | 368,015 |

In the following table it will be seen that Canadian apatite plays a by-no-means unimportant part in the trade of Great Britain in phosphates:—

### PHOSPHATE.
### TABLE 2.
### GREAT BRITAIN: IMPORTS OF CANADIAN APATITE COMPARED WITH TOTAL IMPORTS OF PHOSPHATES IN THAT COUNTRY.

| Year. | Canadian Apatite. | | Total Phosphates. | | Per cent of Value of Canadian Apatite to total Value. |
|---|---|---|---|---|---|
| | Long Tons — 2,240 lbs. | £ stg. | Long Tons — 2,240 lbs. | £ stg. | |
| 1882 | 8,187 | 39,851 | 199,428 | 613,198 | 6·5 per cent. |
| 1883 | 16,531 | 66,714 | 246,945 | 813,825 | 8·2 " |
| 1884 | 15,716 | 52,370 | 219,225 | 643,851 | 8·1 " |
| 1885 | 21,484 | 76,179 | 238,572 | 628,027 | 12·1 " |
| 1886 | 18,069 | 63,490 | 223,111 | 526,885 | 12·0 " |
| 1887 | 19,194 | 65,974 | 283,415 | 614,088 | 10·7 " |
| 1888 | 12,423 | 42,291 | 257,886 | 544,919 | 7·7 " |
| 1889 | 23,123 | 71,037 | 304,953 | 703,704 | 10·1 " |
| 1890 | 21,089 | 65,420 | 343,501 | 849,452 | 7·8 " |
| 1891 | 15,918 | 54,235 | 256,772 | 628,395 | 8·6 " |

ALFRED R. C. SELWYN, C. M. G. LL. D., F. R. S. DIRECTOR.

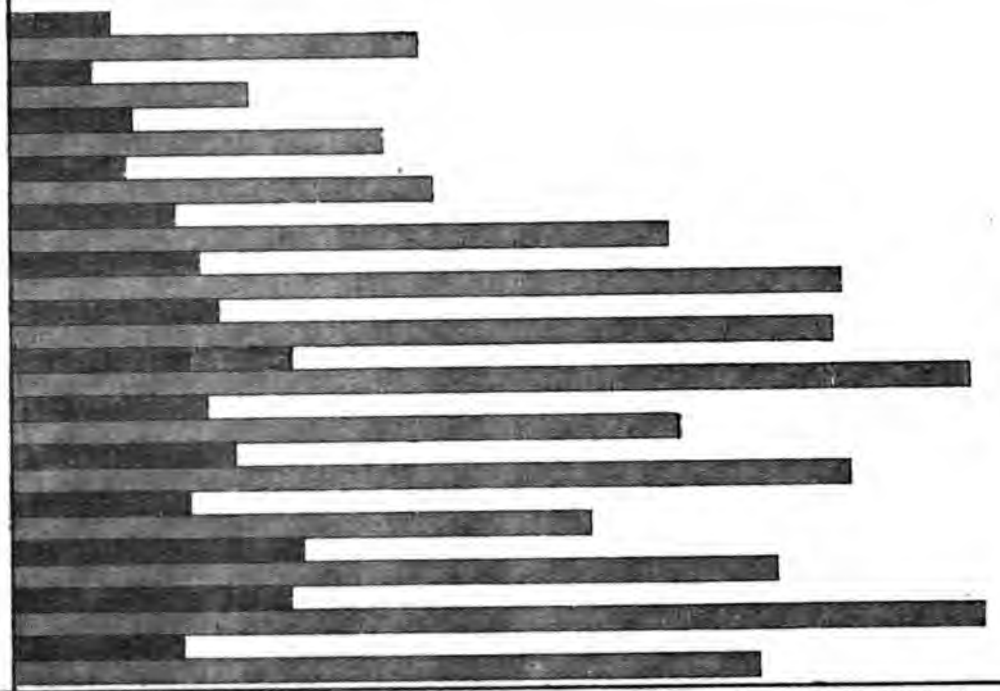
PLATE X.

## PHOSPHATE

### TABLE A

ANNUAL EXPORTS.

| Year | Quantity<br>Tons | Value<br>$ |
|---|---|---|
| 1878 | 10,743 | 208,109 |
| 1879 | 8,446 | 122,035 |
| 1880 | 13,060 | 190,086 |
| 1881 | 11,968 | 218,456 |
| 1882 | 17,153 | 338,357 |
| 1883 | 19,716 | 427,668 |
| 1884 | 21,709 | 424,240 |
| 1885 | 28,969 | 496,293 |
| 1886 | 20,440 | 343,007 |
| 1887 | 23,152 | 433,217 |
| 1888 | 18,776 | 298,609 |
| 1889 | 29,987 | 394,768 |
| 1890 | 28,457 | 499,369 |
| 1891 | 17,271 | 384,661 |



ANNUAL REPORT FOR 1891; DIVISION OF MINERAL STATISTICS AND MINES.
E. D. INGALL, M. E., IN CHARGE.

PART S. S.; ANNUAL REPORT, 1891-92, Vol. VI.

## THE PRECIOUS METALS.

### GOLD.

THE PRECIOUS METALS.
Gold—Production.

The production of gold for 1891 was 51,303 oz., valued at $930,614, as compared with 64,046 oz. in 1890, valued at $1,149,776. The details of this production are given in Table 1, which, compared with the figures for last year, shows the following features.

Nova Scotia shows a falling off of 1,204 oz., and British Columbia of 3,801 oz., whilst the estimated quantity for the North-west Territories and Yukon district is less by 7,853 oz. Quebec and Ontario only register a slight increase of 115 oz. on their small production.

The alluvial gold product of British Columbia, added to that resulting from the mining of the auriferous lodes of Nova Scotia, constituted, as in the past, all but a small fraction of the production given above. The deficit in the former province is due to the continuation of the exhaustion of the shallower placer deposits which have hitherto furnished nearly all the gold. The falling off due to this cause is clearly shown in the graphic table A, showing an almost uninterrupted shrinking of the yield from almost four million dollars in 1863, till in 1891 it is but a little over one-tenth of that amount.

Of the other items in the below given Table No. 1, the amount credited to Ontario is due to the working of quartz; that credited to Quebec is a close estimate of the results of the gold washed from the gravels of the Chaudière district.

The amount credited to the North-west Territories, &c., comprises a close estimate of the gold washed out of the bars of the Saskatchewan River, together with the mean of several estimates of the gold washed on the Yukon River in Canadian territory.

GOLD.

TABLE 1.

PRODUCTION BY PROVINCES.

| Provinces. | Ounces. | Value. | No. of Men. |
|---|---|---|---|
| Nova Scotia | 23,154 | $451,503 | 498 |
| Quebec | 90 | 1,800 | ..... |
| Ontario | 100 | 2,000 | 19 |
| North-west Territories (including Yukon District) | 2,676 | 45,500 | 100 |
| British Columbia | 25,283 | 429,811 | 1,199 |
| Total | 51,303 | 930,614 | 1,816 |

THE PRECIOUS METALS.
Gold—Production.

BRITISH COLUMBIA.—The statistical details regarding the gold-mining industry of this province, as supplied by the Provincial Department of Mines, have been compiled, and are given in Tables A, B, C and No. 2.

The amounts of gold reported by the banks of the province, as exported during the year, are as follows:—

| | |
|---|---|
| Bank of British Columbia | $196,588 |
| Messrs. Garesche, Green & Co | 144,654 |
| Bank of British North America | 16,934 |
| | $358,176 |
| Add one-fifth; estimate of gold carried away in private hands | 71,635 |
| Production of gold as estimated by the provincial authorities | $429,811 |

### GOLD.

### TABLE 2.

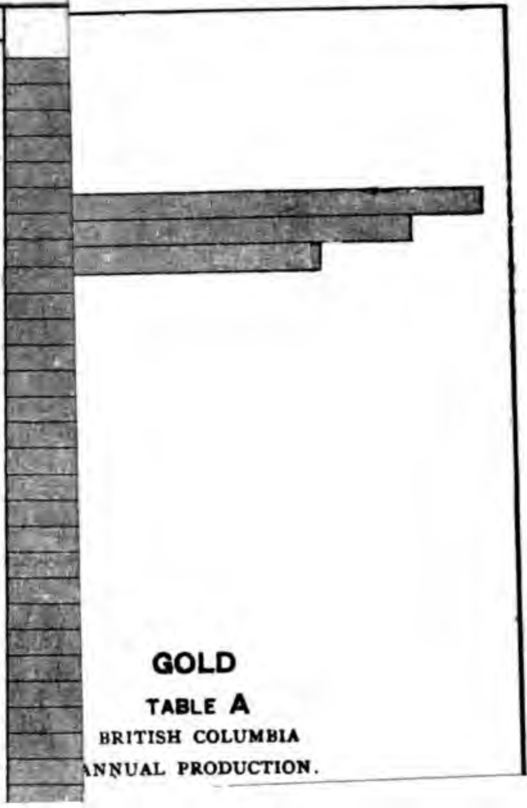
### BRITISH COLUMBIA.

### YIELD, ETC., BY DISTRICTS.

| District. | Divisions. | Men Employed. | | Yield of Gold by Divisions. | Total Yield by Districts. |
|---|---|---|---|---|---|
| | | Whites. | Chinese. | | |
| Cariboo | Barkerville | 77 | 136 | $63,450 | |
| | Lightning Creek | 26 | 111 | 33,850 | |
| | Quesnelle Mouth | 3 | 97 | 30,650 | |
| | Keithley Creek | 68 | 261 | 57,100 | |
| | | 174 | 605 | | $185,050 |
| Cassiar | Laketon | .... .... | ... .. .. | 40,000 | 40,000 |
| Kootenay | Western | 35 | ...... | 13,000 | |
| | Eastern | 9 | 48 | 28,550 | |
| | | 44 | 48 | | 41,550 |
| Lillooet | ... .. ... ... .. | 35 | 60 | 52,506 | 52,506 |
| Yale | Osoyoos | 62 | 45 | 11,000 | |
| | Similkameen | 58 | 68 | 21,100 | |
| | | 155 | 173 | | 32,100 |
| | | | | | $351,206 |
| | Total Whites | 373 | | | |
| | " Chinese | .... .... | 826 | | |
| | " employed | 1,199 | | | |

PLATE VI.

| Year | Value |
|---|---|
| 1858 | $705,000 |
| 1859 | 1,615,072 |
| 1860 | 2,228,543 |
| 1861 | 2,666,118 |
| 1862 | 2,656,903 |
| 1863 | 3,913,563 |
| 1864 | 3,735,850 |
| 1865 | 3,491,205 |
| 1866 | 2,662,106 |
| 1867 | 2,480,868 |
| 1868 | 2,372,972 |
| 1869 | 1,774,978 |
| 1870 | 1,336,956 |
| 1871 | 1,799,440 |
| 1872 | 1,610,972 |
| 1873 | 1,305,749 |
| 1874 | 1,844,618 |
| 1875 | 2,474,904 |
| 1876 | 1,786,648 |
| 1877 | 1,608,182 |
| 1878 | 1,275,204 |
| 1879 | 1,290,058 |
| 1880 | 1,013,827 |
| 1881 | 1,046,737 |
| 1882 | 954,085 |
| 1883 | 794,252 |
| 1884 | 736,165 |
| 1885 | 713,738 |
| 1886 | 903,651 |



**GOLD**

**TABLE A**

BRITISH COLUMBIA

ANNUAL PRODUCTION.

THE PRECIOUS METALS.
Gold—Production.

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| | $358,176 |
| Add one-fifth; estimate of gold carried away in private hands | 71,635 |
| Production of gold as estimated by the provincial authorities | $429,811 |

GOLD.

TABLE 2.

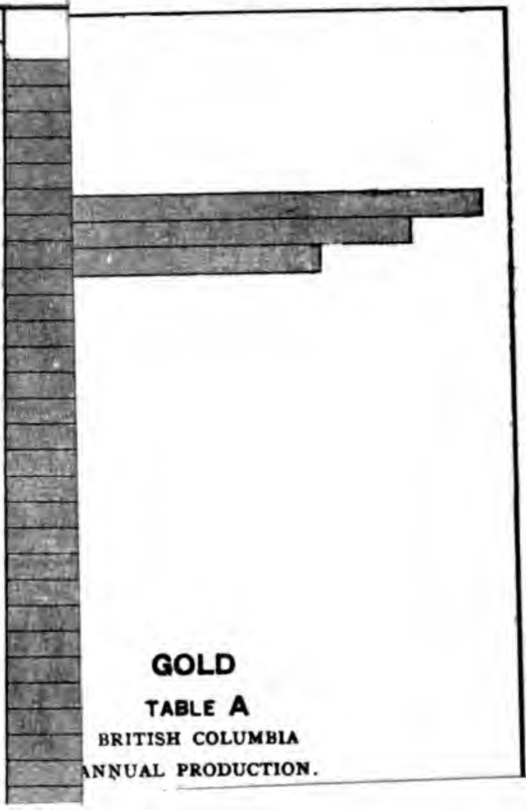
BRITISH COLUMBIA.

YIELD, ETC., BY DISTRICTS.

| District. | Divisions. | Men Employed. | | Yield of Gold by Divisions. | Total Yield by Districts. |
|---|---|---|---|---|---|
| | | Whites. | Chinese. | | |
| Cariboo.... | Barkerville.......... | 77 | 136 | $63,450 | $185,050 |
| | Lightning Creek..... | 26 | 111 | 33,850 | |
| | Quesnelle Mouth. ... | 3 | 97 | 30,650 | |
| | Keithley Creek . ... | 68 | 261 | 57,100 | |
| | | 174 | 605 | | |
| Cassiar..... | Laketon .. ........ | .... .... | ... . .. | 40,000 | 40,000 |
| Kootenay.. | Western. ........... | 35 | ...... | 13,000 | 41,550 |
| | Eastern.............. | 9 | 48 | 28,550 | |
| | | 44 | 48 | | |
| Lillooet.... | ..... .. ... ..... .. | 35 | 60 | 52,506 | 52,506 |
| Yale ...... | Osoyoos ............. | 62 | 45 | 11,000 | 32,100 |
| | Similkameen . ...... | 58 | 68 | 21,100 | |
| | | 155 | 173 | | |
| | | | | | $351,206 |
| | Total Whites. ... | 373 | | | |
| | " Chinese ..... | .... .... | 826 | | |
| | " employed.... | 1,199 | | | |

PLATE VI.

| Year | Value |
|---|---|
| 1858 | $705,000 |
| 1859 | 1,615,072 |
| 1860 | 2,228,543 |
| 1861 | 2,666,118 |
| 1862 | 2,656,903 |
| 1863 | 3,913,563 |
| 1864 | 3,735,850 |
| 1865 | 3,491,205 |
| 1866 | 2,662,106 |
| 1867 | 2,480,868 |
| 1868 | 2,372,972 |
| 1869 | 1,774,978 |
| 1870 | 1,336,956 |
| 1871 | 1,799,440 |
| 1872 | 1,610,972 |
| 1873 | 1,305,749 |
| 1874 | 1,844,618 |
| 1875 | 2,474,904 |
| 1876 | 1,786,648 |
| 1877 | 1,608,182 |
| 1878 | 1,275,204 |
| 1879 | 1,290,058 |
| 1880 | 1,013,827 |
| 1881 | 1,046,737 |
| 1882 | 954,085 |
| 1883 | 794,252 |
| 1884 | 736,165 |
| 1885 | 713,738 |
| 1886 | 903,651 |



## GOLD

### TABLE A

BRITISH COLUMBIA
ANNUAL PRODUCTION.

**THE P**
**META**
Gold—
Produ

Plate VII.

| Value | |
|---|---|
| $141,871 | |
| 272,448 | |
| 390,349 | |
| 496,357 | |
| 491,491 | |
| 532,563 | |
| 400,555 | |
| 348,427 | |
| 387,392 | |
| 374,972 | |
| 255,349 | |
| 231,122 | |
| 178,244 | |
| 218,629 | |
| 233,585 | |
| 329,205 | |
| 245,253 | |
| 268,328 | |
| 257,823 | |
| 209,755 | |
| 275,090 | |
| 301,207 | |
| 313,554 | |
| 432,971 | |
| 455,564 | |
| 413,631 | |
| 436,939 | |
| 510,022 | |
| 474,990 | |
| 451,511 | |

## GOLD
### TABLE F
QUEBEC
ANNUAL PRODUCTION.

Th
M
Go
Pro

THE PRECIOUS METALS.
Gold—Production.

VA SCOTIA.—The statistical details regarding the gold-mining try in this province are given in the accompanying tables, ic D and E] and Nos. 3 and 4, which are compiled from data ted by the Provincial Department of Mines. From these it is that whilst there is a decrease in the total yield of gold and the er of tons crushed, the yield of metal per ton milled shows a increase over last year.

## GOLD.

### TABLE 3.

### NOVA SCOTIA.

### ODUCTION OF THE DIFFERENT DISTRICTS FROM 1862 TO 1891, INCLUSIVE.

| Districts | Tons of Quartz Crushed. | Total Yield. | | | | Average yield per ton of 2,000 lbs. |
|---|---|---|---|---|---|---|
| | | Ozs. | Dwts. | Grs. | Value at $19.50 per oz. | |
| ou and Moose River.. | 49,760 | 25,541 | 17 | 10 | $ 498,066 | $10·01 |
| ague........ ....... | 17,055 | 33,942 | 12 | 16 | 661,881 | 38·81 |
| am. ............... .. | 40,166 | 44,151 | 16 | 16 | 860,960 | 21·43 |
| ew .... ..... . .... | 46,071 | 31,814 | 13 | 2 | 620,385 | 13·46 |
| rooke............... | 166,295 | 119,767 | 9 | 2 | 2,335,465 | 14·04 |
| ont . ... ........... | 23,124 | 24,266 | 6 | 9 | 473,193 | 20·45 |
| ier.......... ..... .. | 29,492 | 19,198 | 8 | 6 | 374,369 | 12·69 |
| ke ................. | 39,207 | 24,896 | 2 | 8 | 485,474 | 12·38 |
| rley. ..... . ...... | 94,692 | 54,476 | 3 | 14 | 1,062,285 | 11·22 |
| on River... .. ..... | 39,785 | 12,121 | 4 | 0 | 236,363 | 5·94 |
| field .... ......... | 5,663 | 4,858 | 4 | 9 | 94,735 | 16·73 |
| eburn........ . ..... | 5,875 | 9,281 | 2 | 20 | 180,981 | 30·83 |
| Catcha ... ........ | 6,459 | 7,430 | 19 | 3 | 144,913 | 22·44 |
| lon . .... ...... .... | 11,389 | 9,060 | 14 | 4 | 176,683 | 15·51 |
| ........ ....... | 379 | 354 | 6 | 16 | 6,909 | 18·23 |
| Harbour........... | 41,798 | 28,639 | 6 | 1 | 558,466 | 13·36 |
| s Hill . ...... .... | 39,909 | 18,715 | 19 | 19 | 364,962 | 9·14 |
| n Mile Stream...... | 13,363 | 7,547 | 2 | 5 | 147,168 | 11·01 |
| ga. . .... .......... | 15,847 | 12,687 | 4 | 18 | 247.400 | 15·61 |
| oclaimed, etc ........ | 53,178 | 40,950 | 15 | 21 | 798,540 | 15·01 |
| Totals........... | 739,507 | 529,702 | 9 | 7 | 10,329,198 | 13 97 |

THE PRECIOUS METALS.
Gold—Production.

### GOLD.

### TABLE 4.

### NOVA SCOTIA.

### DISTRICT DETAILS.

| Districts. | Number of Mines. | Mills. | Tons of Quartz Crushed. | Yield of Gold per Ton. Ozs. | Dwts. | Grs. | Total Yield of Gold. Ozs. | Dwts. | Grs. |
|---|---|---|---|---|---|---|---|---|---|
| Tangier | 2 | 1 | 370 | 0 | 3 | 21 | 71 | 12 | 12 |
| Whiteburn | 1 | 2 | 890 | 1 | 0 | 3 | 895 | 7 | 4 |
| Central Rawdon | 1 | 1 | 510 | 0 | 1 | 8 | 342 | 0 | 0 |
| Killag | 1 | 1 | 379 | 0 | 18 | 11 | 354 | 6 | 16 |
| Oldham | 2 | 2 | 2,019 | 1 | 9 | 0 | 2,909 | 10 | 13 |
| Caribou<br>Moose River | 3 | 4 | 5,801 | 0 | 5 | 23 | 1,723 | 5 | 21 |
| Wine Harbour | 1 | 1 | 1,823 | 0 | 7 | 15 | 698 | 9 | 0 |
| Waverley | 3 | 3 | 1,611 | 0 | 7 | 11 | 602 | 4 | 0 |
| Lake Catcha | 1 | 1 | 2,432 | 0 | 6 | 13 | 800 | 3 | 0 |
| Fifteen Mile Stream | 2 | 2 | 4,862 | 0 | 10 | 12 | 2,550 | 10 | 12 |
| Uniacke | 3 | 4 | 1,854 | 1 | 12 | 21 | 3,045 | 5 | 4 |
| Montague | 2 | 3 | 863 | 1 | 11 | 10 | 1,361 | 1 | 0 |
| Stormont | 2 | 4 | 888 | 2 | 1 | 21 | 1,025 | 12 | 4 |
| Malaga | 2 | 2 | 4,826 | 0 | 19 | 12 | 4,827 | 8 | 17 |
| Salmon River | 1 | 1 | 5,210 | 0 | 5 | 9 | 1,406 | 0 | 0 |
| Sherbrooke | 4 | 2 | 464 | 0 | 5 | 3 | 119 | 5 | 0 |
| Unproclaimed, etc | 3 | 5 | 1,549 | 0 | 5 | 11 | 421 | 18 | 4 |
| Totals and averages | 34 | 39 | 36,351 | 0 | 12 | 17 | 23,153 | 19 | 11 |

Graphic Table F shows the production of Quebec to remain at a very unsatisfactory point, but there is reason to hope for an increased yield for next year in view of the contemplated renewal of work on the Gilbert River under the management of Mr. Arthur Lockwood.

Gold—Exports.

### GOLD.

### TABLE 5.

### EXPORTS.

| Provinces. | 1887. | 1888. | 1889. | 1890. | 1891. |
|---|---|---|---|---|---|
| | $ | $ | $ | $ | $ |
| Ontario | 6,650 | ..... | 2,660 | ......... | 1,000 |
| Nova Scotia | 321,379 | 163,412 | 191,671 | 304,521 | ... |
| Manitoba | ....... | 50 | 261 | ....... | 110 |
| British Columbia | 592,300 | 464,696 | 414,658 | 402,271 | 343,582 |
| Totals | 920,329 | 628,158 | 609,250 | 706,792 | 344,692 |

**THE PRECIOUS METALS.**

## SILVER.

**Silver—Production.**

From information obtained directly by the Division, the production of silver in the Dominion during 1891 had a value of $406.233, which at the average market price for the year of 98 cts.=414,523 ozs. This amount represents the calculated silver contents of the argentiferous iron and copper pyrites mined in the Eastern Townships of Quebec, together with the production of the silver mines proper of the Thunder Bay district of Ontario, including also a small amount entered as exported from British Columbia, and the silver contents of a small amount of argentiferous galena mined in the province of Quebec. This amount shows an increase of 13,836 ozs. over the production of last year, but a decrease of $14,489 owing to the considerable depreciation in the value of the metal.

Table No. 1 below shows the progress of the industry for the past five years.

### SILVER.

### TABLE 1.

### PRODUCTION OF SILVER.

| YEAR. | ONTARIO. | | QUEBEC. | | BRITISH COLUMBIA. | | TOTAL. | |
|---|---|---|---|---|---|---|---|---|
| | Ozs. | Value. | Ozs. | Value. | Ozs. | Value. | Ozs. | Value. |
| | | $ | | $ | | $ | | $ |
| 1887. .... | 190,495 | 190,495 | 146,898 | 146,898 | 11,937 | 11,937 | 349,330 | 349,330 |
| 1888. .... | 208,064 | 208,064 | 149,388 | 149,388 | 37,925 | 37,925 | 395,377 | 395,377 |
| 1889. ... | 181,609 | 162,309 | 148,517 | 133,666 | 53,192 | 47,873 | 383,318 | 343,848 |
| 1890. .... | 158,715 | 166,652 | 171,545 | 180,122 | 70,427 | 73,948 | 400,687 | 420,722 |
| 1891. .... | 225,633 | 221,120 | 185,584 | 181,872 | 3,306 | 3,241 | 414,523 | 406,233 |

**Price.**

Graphic Table A illustrates clearly the fluctuation in value of the metal during 1891 as per New York quotations, the general depreciation in value having continued almost uninterruptedly since the middle of August last when the metal was quoted as high as $1.19.

THE PRECIOUS METALS.
Silver—Exports.

The exports of the ores of this metal as compiled from the books of the Customs Department are given in Table 2 following.

SILVER.

TABLE 2.

EXPORTS OF SILVER ORE.

| Province. | 1887. | 1888. | 1889. | 1890. | 1891. |
|---|---|---|---|---|---|
| Ontario | $184,763 | $208,064 | $203,871 | $203,142 | $222,071 |
| Quebec | 450 | 5 | 2,500 | 900 | ....... |
| Nova Scotia | ......... | ....... | 50 | ....... | ......... |
| Manitoba | 3,741 | ....... | 5 | ....... | ....... |
| British Columbia | 17,331 | 10,939 | 5,737 | 100 | 3,241 |
| Totals | $206,285 | $219,008 | $212,163 | $204,142 | $225,312 |

Discovery and development.—Gold and Silver.

## DISCOVERY AND DEVELOPMENT.

### GOLD AND SILVER.

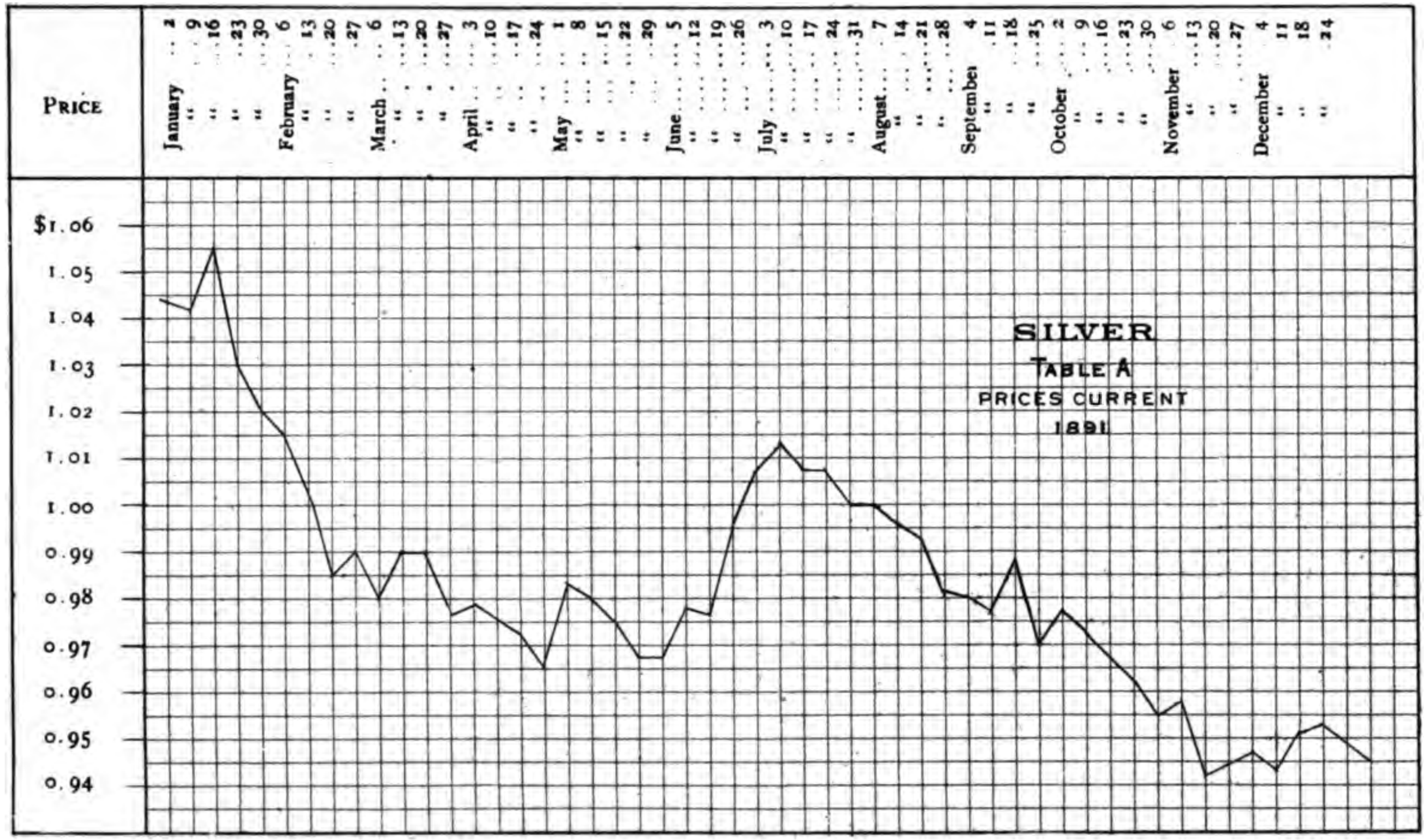
The progress of discovery and development of the mineral resources of the country in respect to gold and silver are best considered together.

Nova Scotia.

NOVA SCOTIA.—Beginning then on the eastern coast with the mining operations of Nova Scotia, operations were continued in developing the numerous gold-bearing quartz leads found in the Cambrian rocks of the Atlantic slope of the peninsular portion. Scattered all along this district, between the centre and the coast, are numerous sub-districts whose names are set forth in Gold table 3, which includes some thirty-four separate mines.

The details of this industry are given in the undermentioned extracts from the report of the inspector of mines for the province, from which it will be seen that mining still continues to be carried on mostly by comparatively small operators, employing forces of men numbering 50 or less, the mills ranging from ten to fifty heads of stamps.

"The various districts were visited by Mr. Maddin, deputy inspector, who reports the mines generally in fair order and safe. With respect to some mines, arrangements have been made for introducing better and safer ladders. The ephemeral system of gold mining which prevails in this province, makes it very difficult for the department to exercise anything like a close and regular supervision over the smaller


SILVER
TABLE A
PRICES CURRENT
1891
PRICE
$1.06
1.05
1.04
1.03
1.02
1.01
1.00
0.99
0.98
0.97
0.96
0.95
0.94
January .. 2
" .. 9
" .. 16
" .. 23
" .. 30
February .. 6
" .. 13
" .. 20
" .. 27
March .. 6
" .. 13
" .. 20
" .. 27
April .. 3
" .. 10
" .. 17
" .. 24
May .. 1
" .. 8
" .. 15
" .. 22
" .. 29
June .. 5
" .. 12
" .. 19
" .. 26
July .. 3
" .. 10
" .. 17
" .. 24
" .. 31
August .. 7
" .. 14
" .. 21
" .. 28
September .. 4
" .. 11
" .. 18
" .. 25
October .. 2
" .. 9
" .. 16
" .. 23
" .. 30
November .. 6
" .. 13
" .. 20
" .. 27
December .. 4
" .. 11
" .. 18
" .. 24

THE PRECIOUS METALS.
Discovery and development.
—Nova Scotia

mines. A small mine is rapidly opened out and abandoned within a few months. The work being tentative, little attention is paid to points which receive the attention of a manager in larger and more ambitious workings. The enforcement, in all gold mines, of a strict adherence to the letter of the Mines Regulation Act would require the services of a man specially devoted to the work. There should also be some system adopted of keeping a check on the work performed in the mills. At present the returns are received as made; and it is believed that there are annually considerable unaccounted for amounts of gold extracted from rich quartz by hand, on which no royalty is paid.

"At Wine Harbour, * * R. McNaughton was working, with Adam McGrath as under-manager. The middle lead was stripped and operations began on the Caledonia lead; twenty men were employed underground, and ten men overground. * * *

"At Goldenville, George Hirschfield was working in the McLean lead, employing four men taking out the roof quartz, allowing the waste to fall down the mine, and making an opening for water. The Sutherland and Chicago mines were idle, but the Blackie mine was at work, employing six men, and things appeared very dull in this mining camp. At Ecum Secum the mine was idle. There are very many complaints against so many trial pits being left open unguarded.

"At Dufferin Mine, Salmon River, South and North leads working, and down from 250 to 300 feet; thirty men are employed. A new twenty stamp mill has been erected, a self-feeding Blake's Rock Breaker is also used at this mill, and all the machinery is run by water power.

"Visited Tangier Mine, and found mining matters very dull. One of the old veteran miners, John Murphy, had four or five men employed on the Strawberry Hill lead, which was all the work that was being done in this vicinity.

"At Oxford Gold Mining Company, East Chezzetcook, J. M. Reade, manager, with thirty-one men employed. This mine is very well equipped with good machinery. Compressed air is utilized in doing a very large amount of the work. * * * John H. Anderson had six men employed erecting a new mill, and N. McMillan had four men employed opening up "Colman lead," or "Annand Mine."

"At Montague Mines, Alex. P. McQuarrie, manager, and W. Collins, under-manager, twenty-eight men employed. They were at work taking down the old mill and preparing to rebuild and put in a new battery, and from the appearance of the mine and the push of the management, with such a body of good practical men as are here, I

THE PRECIOUS METALS. Discovery and development. —Nova Scotia

should think we shall have good accounts of this mine in the near future. In this district there is also the Hay Mine, Wm. Skerry, manager, with fourteen men employed. Here they have had a difficult task to keep the water out, but I am glad to say that, at the date of my visit, Mr. Skerry had almost overcome this difficulty, and was getting his mine timbered and fixed up. T. M. Baker is also at work on the iron lead, so called, employing three men; and Mr. Pratt is working the Sutherland mine, on what is supposed to be the iron lead, employing three men.

" At Lake View Mining Co., Waverley, A. A. Hayward, manager, and Matt. Thompson, under-manager. This mine was idle at the time of my visit, but it is one of the best equipped that I saw. There are seven drills run by compressed air; one of Gates' Rock Breakers, self-feed; thirty stamp mill; boilers, 280 H.P.; mill engine, 230 H. P.; hoisting engine, 130 H.P.; pump engine, 25 H.P.; a compressor engine, 50 H.P.; shaft, 300 feet depth; self-dumping skips. This mine did employ fifty men. The water was out when I was there, affording an opportunity of travelling all through it.

" In this district there is also the West Waverley Mine, John Hardman, manager. Some thirty men employed. The mine was idle, but the men were employed erecting new mill and new hoist. Windsor Junction Mine, Capt. Geo. McDuff, manager. Some sinking has been done here.

" Renfrew Mine, R. S. Turnbull, manager, A. Manning, under-manager. Mine down 400 feet, and in good order and condition.

" At Gay's River Mine, R. R. McLeod, manager, with forty men employed. A fifty stamp mill has been erected; this mill was built by the Truro Foundry Co. The gold is obtained here chiefly from the surface.

" Moose River, Mr. Touquoy, manager; seventeen men employed. A fifteen stamp mill and three pumps run by water power, with plenty water to run as many more. In this district A. McGregor and Wm. Bruce are working on the Moose River property, with ten men employed.

" At Caribou district, L. L. Wordsworth, manager. This mine is down some 400 feet, and at the date visited was very poorly timbered.

* * *

In this district Mr. Dickson is doing a very good paying work, and his mine was in good shape.

" The mines which I have visited to this date* were all well ventilated and timbered, with one or two exceptions. I may, however, say that instead of hanging ladders on the foot wall in those mines where the angle is so high, it would be much better to hang them lengthways on the lead--they would then have more slope. At present in many of the mines the ladders are nearly perpendicular, in distance ranging from 50 to 200 feet, and no means provided to save a man if he were accidentally to stumble and fall. I am pleased to say that very few accidents have occurred, but as the shafts are gradually becoming deeper, the time has arrived when such a preventive to accidents as I have suggested should be adopted.

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* Aug. 15, '91.

THE PRECIOUS METALS. Discovery and development. --Nova Scotia

### *Queen's County.*

"Whiteburn district, Rossignol Mine. This mine has been idle for some time, and is just getting fairly started. F. B. Murchy, Esq., manager, says he expects to do well this winter. There are 20 men employed, and have a ten stamp mill running, and everything looks well about the mine.

"Whiteburn Mine, -- Partinger, manager, Michael Kelly, under-manager, with forty men employed. The shaft is 200 feet deep, and well timbered. Ten stamp mill. The perpendicular lead or mine is idle; the manager is prospecting close by the old shaft. Everything looks satisfactory around this mine.

"Malaga Gold Mining District, G. A. Wade, manager, John Thornholm, under-manager. Twenty-seven men employed, two shafts working. Main shaft 200 feet deep. The travelling way is the best I have seen; the ladders are at an easy angle, and stages every 20 feet. * * * North of this F. H. Ballou is working, employing some thirty men; his travelling way is very good. I may say all the travelling ways in this county are good. A little east of this, Charles McLeod is working in the Nine Bolder lead, so called, employing eight men. The Caledonia Mine is idle, their mill house was accidentally burned some time ago. The Parker Douglas is also idle, which makes business somewhat dull in this locality.

"I visited Brookfield Mine, G. A. Kenty, manager of the Philadelphia Gold Mining Company; they employ thirty men; three shafts working; the main shaft is down 200 feet. All the mines in this county are in good condition, but have not so many men employed in this district as were last year.

"I may say it has hitherto been the prevailing system in the gold mining industry in this province, when the work arrives at a distance of from 200 to 400 feet, to cease operations, the operator in many cases being unable to go deeper on account of the inadequacy of the machinery to go to any greater depth, and because of the fear that at

THE PRECIOUS METALS.
Discovery and development. – Nova Scotia

any "greater depth" gold ceased to be found. I have learned that at Goldenville, however, a shaft has been sunk to a depth of some 600 feet, and paid to the last inch. In my opinion there is very great room for the supposition that some of the most valuable properties in this province are being virtually lost, unless some means be adopted to encourage the operators to prospect some property at a depth of from 1,000 feet to 2,000 feet."

Mr. Faribault has been conducting some very interesting geological investigations for the Survey, which will throw much light upon the nature and geological affinities of these veins, and in his preliminary report on the subject makes the following remarks :—

"The section surveyed this season in Nova Scotia lies westward of that surveyed in 1889 and 1890, and extends along the sea-shore from Porter's Lake to Halifax harbour, and northerly to the Shubenacadie and St. Andrew's rivers, covering an area of 305 square miles in Halifax county and 70 square miles in Colchester county.

"The greater part of the region is occupied by the auriferous Lower Cambrian rocks cut by the western end of the belt of granite examined last year, which extends to within two miles east of Waverley, and also by a small granite mass three miles north of Waverley. In the northern portion, the gold-bearing rocks are overlain by the Lower Carboniferous formation along the valleys of the Shubenacadie, Gay's and St. Andrew's rivers and a few of their tributaries.

"Two or three beds of dolomitic limestone from six inches to four feet thick were found at various places at the bottom of the upper graphitic ferruginous slate group, between layers of greenish talcose slate. These beds may contain fossils, but search made for them has so far proved unsuccessful.

"The anticlinal axes were minutely examined and traced, as in former years, on account of their close relation to the auriferous belts. Within the region examined, the geological structure of the gold district of Lawrencetown, Montague, Waverley and Oldham was carefully studied. Lawrencetown has been but little worked.

"Special attention was given to the gold district of Oldham, it being a typical district, worked to a great extent and exposing to great advantage the quartz leads, all of which were prospected by means of surface trenches on account of the small thickness of the drift. A detailed geological map of this district, on a scale of 500 feet to one inch, with sections, was compiled on the ground. It shows the elliptical structure of the anticlinal fold, with all the known quartz veins, both interbedded and transverse; and also the numerous faults affecting them, and proves clearly that the richness of a lead depends altogether

THE PRECIOUS METALS. Discovery and development —Nova Scotia.

on its position and relation to the structure of the elliptical dome of the fold to which it owes its origin. In this work I am specially indebted to Mr. J. E. Hardman, B.Sc., M.E., manager of gold-mining properties in Oldham and Waverley, for much valuable information which his great experience in gold-mining enabled him to give.

"Auriferous leads have also been prospected at Elmsdale, South-east Passage, and other places along anticlinal axes."

He points out that as the zones containing the rich portions of the veins hold a definite relationship to the structural features of the anticlinal folds of the inclosing rocks, the successful prosecution of deep mining calls for the study of these features in order to locate and trace out these rich zones. He further asserts that as the veins in their extension either in length or depth change their relationship to the axes of the anticlinals their richness is thereby affected. Continuing, he says: "In most of districts the zone of rich leads has the anticlinal axis for its centre, and it is probably the centre of the auriferous zone to a depth practically unlimited. Such is the case in the eastern part of the province, at Seal Harbour, Isaac's Harbour, Goldenville, Harrigan Cove, Salmon River, Fifteen Mile Stream, Killag, Mooseland, Moose River, Caribou, Gold River, Lawrencetown, Waverley and Oldham. In the few other districts where the auriferous zone is worked only on the north or south side of the anticlinal, the zone would, for the same reason, be parallel to the axis of the anticlinal to an inaccessible depth, as in Isaac's Harbour, Wine Harbour, Beaver Dam, Tangier and Lake Catcha.

"The gold district of Gay's River was reopened last spring by the Cole Stream Gold Mining Company, who put up an extensive fifty stamp steam mill and other large buildings. They sank a shaft immediately north of Daniel McDonald's old works, which gave the following section of the Lower Carboniferous:—

| | Feet. |
|---|---|
| Surface drift | 20 |
| Conglomerate, containing gypsum, non-auriferous | 35 |
| Coarse sandstone | 2 |
| Auriferous, irregular conglomerate | 8 |

"This lower auriferous conglomerate is wholly composed of debris of the adjacent Lower Cambrian rocks, apparently in an old river bed, and rests on the lower graphitic ferruginous slate group. Beds of conglomerate similarly situated along the northern boundary of the gold-bearing rocks may prove sufficiently rich to be worked, but the great excitement caused two years ago by exaggerated reports of dis-

THE PRECIOUS METALS. Discovery and development —Nova Scotia

coveries of gold in various places, remote from the gold-bearing rocks, have led a great many to take up valueless ground." (See Summary Report for 1890, page 41.)

Dr. Selwyn expresses concurrence in these conclusions as follows:—

Personal observation enables me to concur in the opinion he expresses both as regards the correspondence of the Quebec gold-bearing rocks with those of Nova Scotia, and also as regards the position of the rich leads and their relation to axial folds. The latter, if correct, must prove of the greatest practical importance if intelligently applied in the further development of gold mining in Nova Scotia and also in directing prospecting for veins in the alluvial fields in Quebec.

New Brunswick.

NEW BRUNSWICK.—In New Brunswick the small amount of work done was altogether of the nature of test explorations. Several of these were visited by Mr. Brumell, who gleaned the following information :

"At the Britton Mine, near Woodstock, when visited on 17th August, it was found that operations were partly suspended owing to an accident to the pump.

"The shaft was down 150 feet, levels running off at 50 feet, 100 feet, 137 feet and 144 feet, the two latter running 25 feet to the north and south and 25 feet N.N.W. respectively.

"The manager claims to have a four-foot vein in the 144-foot level from which came the samples which were shown me. These together with those to be seen on the dump were very poor, containing but slight traces of mineral. Assays of ore said to be from this level are as follows :—

By W. A. Gould, Sussex, N.B.

| | | |
|---|---|---|
| Gold | 3¼ dwts. | Ton 2,240 lbs. |
| Lead | 283 lbs. | |
| Silver | 4¼ ozs. | |
| Copper | 9 lbs. | |

By John McVicker, Salt Lake City, U.S.A.

| | | |
|---|---|---|
| Lead | 11·4% | Ton 2,000 lbs. |
| Silver | $4.62 | |
| Gold | 0.58 | |

Another assay of ore not, however, from the same part of the mine as the above gave Mr. Gould the following result :—

| | | |
|---|---|---|
| Gold | 4¼ dwts. | Ton 2,240 lbs. |
| Lead | 23 lbs. | |
| Silver, | trace. | |
| Copper | do | |

THE PRECIOUS METALS. Discovery and development —New Brunswick.

"At Nauwigewauk, prospecting operations were undertaken during the year by the New Brunswick Mineral Developing Company, of which Mr. J. DeWolfe Spurr, of St. John, is president, and Mr. G. Wetmore Merritt, secretary. The work was done with a view of testing the auriferous character of the Lower Carboniferous conglomerates of the district, and the results are said to have shown the more pebbly portions of the beds to carry as high as four pennyweights in gold to the ton. The gold is free and very fine, and apparently contained in the quartz pebbles which make up a considerable proportion of the rock. The conglomerate beds consist of interstratified coarse sandstones and pebble beds, the pebbles being of quartz, Lower Carboniferous shale and limestone, and have a general strike nearly east and west, the dip being about 80° to the north.

"In the work of prospecting, besides having assays made of many specimens collected at different points, the company drove a tunnel about fifteen feet across the beds with, it is said, encouraging results. The supply of rock is practically inexhaustible, timber plentiful, the situation favourable, being on the Intercolonial Railway, and water may be obtained from the Hammond River, which flows through the property. It is said that negotiations are pending with a New York Company who profess to be able to make the property pay if three pennyweights per ton are available.

"At Moore's Lake, near St. Stephen, Charlotte county, on the property mentioned in the article on nickel, is a vein of pure, white quartz, about two inches wide, striking N. 80° E., and dipping at an angle of 82° to the north, and which is said to carry gold, the ore assaying, it is said, from four to twenty dollars per ton in gold. The lead cuts rocks, which near the vein are dioritic, though they pass imperceptibly into rocks with a marked schistose character. The schistose rocks strike nearly north and south, and dip at an angle of 30° to the east.

"On Sawmill Creek, near Memel, prospecting was being carried on by J. F. Fraser, of St. John, *et al.*, on a band of altered mica-schist, which contains a considerable percentage of pyrites scattered through the mass. The rocks strike N. 70° W. and dip $<$ 55° N.

"At Peck's Creek, Albert county, about two miles west of the Albert mines, similar rocks are met with, and a small amount of prospecting done. These rocks strike N. 30° E. $<$ 55° N. The rock from these beds is said to have yielded as high as 8 dwts. per ton in a mill test.

"Assays of average specimens from both of these places were made by Mr. Hoffmann, of which he furnishes the following :—

THE PRECIOUS METALS. Discovery and development—New Brunswick.

1. From Sawmill Creek, Albert county, N.B., a light gray felsite-schist, through which was disseminated numerous small grains of pyrite.

It contained neither gold nor silver.

2. From Peck's Creek, Albert county, N.B., a gray felsite-schist, through which was disseminated numerous small grains of pyrite.

It contained neither gold nor silver.

"Rocky Brook, Millstream River.—This property—one of several in the neighbourhood—is owned by Wm. R. Payne, of Newcastle, and is situated on Rocky Brook, a tributary of the Nepisiguit Millstream, and about 17 miles from Bathurst. The vein which is 17 ft. wide, shows strong in highly altered slate—'country' rock—strikes N. 70° E. < 65° S., running in from its first exposure on the east bank of Rocky Brook. It consists of a mixture of quartz and argillaceous material, carrying iron and copper pyrites, galena and a small proportion of calcite. Possibly the average of the entire width might be even too low to pay for milling, but through the width of the vein proper are several comparatively wide pay streaks, which consist almost entirely of fine-grained argentiferous galena. The location of the property is very favourable for operations, as water and timber are both plentiful and close to the vein. The developments are as yet but small in extent, and consist of a stripping on the bank of the brook and about 100 yards further east and on the vein, a shaft about 12 ft. deep. In both of these places, the vein shows strong, and between very distinct walls.

"A good trail has been cut in from the road above Ste. Thérèse, and every opportunity is afforded of making a good wagon road.

"The following assays have been made for Mr. Payne by J. T. Donald, of Montreal:—

From stripping on creek:

| | Ozs. | Dwts. | Grs. |
|---|---|---|---|
| Gold | 2 | 6 | 16 |
| Silver | 7 | 7 | 12 |
| Gold | 0 | 11 | 16 |
| Silver | 11 | 0 | 16 |
| Gold | None. | | |
| Silver | 40 | 16 | 16 |
| Gold | 0 | 11 | 16 |
| Silver | None. | | |

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Discovery and development —New Brunswick.

"From same (?) vein further east (which point was not visited, however):

| | Ozs. | Dwts. | Grs. |
|---|---|---|---|
| Gold | 1 | 15 | 0 |
| Silver | 57 | 15 | 0 |
| Gold | 1 | 19 | 0 |
| Silver | 32 | 14 | 0 |
| Gold | Trace. | | |
| Silver | 60 | 1 | 16 |
| Gold | 1 | 10 | 0 |
| Silver | 37 | 6 | 16 |

"An assay made for W. R. Payne by the Geological Survey* gave results as follows:—

"From a vein between Mill Stream and Nigadoo River, parish of Beresford, Gloucester Co.:

| | |
|---|---|
| Gold | trace. |
| Silver | 0·466 ozs. in 2,000 lbs. |

"Mr. Ed. Jack, under date of 29th December, 1891, reports that Messrs. Cook & Son, of Newcastle-on-Tyne, made an assay of 100 lbs. sent to them, and found 37½ ozs. silver and 7 per cent lead per ton. They did not estimate the gold."

Quebec.

QUEBEC.—In the province of Quebec there has been but little done. The washing of the alluvials of the rivers tributary to the Chaudière River, in Beauce county, have been carried on irregularly by a few men with the small product already reported, and some little attention was paid to the quartz reefs of the district.

A small force was at work exploring veins carrying argentiferous galena in this vicinity, in speaking of which the report of the Provincial Government Mining Engineer gives the following assays of specimens:—

Armstrong Silver Mine, Marlow, Beauce:—

| | Principal vein. | Transversal vein. | |
|---|---|---|---|
| Gold | Traces | | Per ton of 2,000 lbs. |
| Silver | 34·04 ozs. | 21·46 ozs. | |
| Insoluble silicious residue | 57·36 p.c. | 51·80 p.c | |

A specimen from the first vein analysed by Mr. Hoffmann, of the Geological Survey of Ottawa, gave:—

Silver.........................34·757 ozs. per ton.

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*Annual Report Geological Survey Dept., vol. IV., 1888-89, p. 29 R.

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Discovery and development —Quebec.

Mr. Faribault visited the Ditton gold district and gives his opinion, in which the Director concurs, that the auriferous rocks of that district are of the same age as those with which his field work has rendered him familiar in Nova Scotia.

"The Little Ditton rocks, like those of Nova Scotia, may be divided into two distinct groups, a lower or quartzite group, and an upper or graphitic ferruginous slate group. They present the same lithological character as the two groups in Nova Scotia, and there are good reasons to believe that the gold of the Ditton alluvial deposits is derived as in Nova Scotia from numerous quartz veins which run along the sharp anticlinal axes into which these rocks have been folded."

Samples were collected by Mr. Giroux from the supposed gold veins of "La Barrière" in the township of Courcelles, county of Joliette, which were alluded to in the last report of the Division* as having been said to have yielded specimens which, assayed by Messrs. Ledoux & Co., of New York, yielded, gold 1·83 ozs. and silver 2 65 ozs. The assays made of Mr. Giroux's specimens, however, by Mr. Hoffmann, chemist to the Survey, showed only a trace of gold and no silver.

The only other production of the precious metals in the province is represented in the silver contents of the shipments of sulphuretted copper ores from the Capelton group of mines, and of the galena of the Temiscamingue mine, already alluded to under the heads of lead and copper.

Ontario.

ONTARIO.—In the Madoc and Marmora gold district more or less work has been done of an exploratory nature, about which Mr. Brumell, who visited the district, gleaned the following information:—

"The Belmont gold mine, located on the E. ½ lot 20, con. I., Belmont, was operated during the summer by the South African General and Exploring Co., and was not visited owing to lack of time; the following information was, however, kindly furnished by Mr. A. W. Carscallen, of Marmora:—

"On the property are several shafts and test pits, the deepest and most important being the Carscallen shaft with a depth of 37 feet. The vein on which this shaft is sunk has widened very materially in descending and has, in the bottom of the shaft, a width of eleven feet six inches and dips to the south-west at an angle of about 80°. The vein throughout shows sulphurets and free gold, an average sample taken from the bottom of the shaft affording $19.11 in gold to the ton of 2,000 lbs. About 500 yards south-east of the above is located the O'Neill shaft with a depth of 14 feet sunk, and a vein running north

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*Report Geol. Surv. of Canada, vol. V., part S, pp. 63 and 66.

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and south and probably a continuation of the vein exposed in the Carscallen shaft.

"The other shafts are the Strickland, East and West, sunk 16 and 12 feet respectively, on a six-foot vein running east and west and dipping about vertically, and the Lingham shaft sunk eight feet on the same vein as that in the Carscallen, and distant about seventy yards to the south-east of that shaft.

"The country rock is a syenitic granite in which the veins are very clearly defined. The ore contains no arsenic, and has assayed as high as $573 in gold to the ton of 2,000 lbs. During November, 1891, thirty men were employed. In the fall a commencement was made to erect a plant of a capacity of fifteen tons per day, which it is expected will be finished early in 1892 ready to treat the ore.

"At the 'Fiegle Mine,' lots 16 and 17, con. XI., Marmora, Ont., the Crescent Gold Mining Co. continued active operations in development and erection of suitable buildings. The mining operations consisted in continuing the old shaft to a depth of 80 feet and the sinking of several test pits and open cuts. During the year they also erected a ten stamp mill, which was in operation up to the end of the year. Thirty men were employed in mining and milling.

"A small amount of development work was done at the 'Demarse Mine' on lot 24, range V. of Marmora township, by Emory Demarse, who sank several test pits on veins in the north-west corner of the lot. Encouraging results were obtained, as the veins afforded rich gold-bearing arsenical pyrites and a small proportion of free gold."

Reports of a number of finds of gold-bearing veins come from the district around Sudbury, but of these no further details are available. Mr. A. E. Barlow visited some of the veins in the township of Creighton and collected specimens, which, however, on being assayed in the laboratory of the Survey, were found to contain neither gold nor silver.

Further west, in the Thunder Bay district, the mines opened some years ago on the silver-bearing veins proper, have been operated during the year. Chief among these are the Beaver, the Badger, the Porcupine, the Shuaniah Weachu or East End Silver Mountain, and the West End Silver Mountain mines, all of which made shipments of silver ore and concentrates. Development work was also conducted on the following properties, viz.: The Palisades; Silver Centre; R. 83; Augusta; Murillo; Y. 5; Gopher; Silver Weasel; Silver Bluff; Silver Martin; Lily of the Valley, and others along the range extending W.S.W. from Port Arthur through the Rabbit Mountain groups to the vicinity of Whitefish Lake.

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Some prospecting work was also done on Arrow Lake further west and also down the coast south from Port Arthur in the neighbourhood of Cloud Bay and Cloud Lake.

In the Black Bay region development work has been recommenced on the vein of argentiferous galena which was discovered years ago by Mr. Duncan McEachren.*

It would be unnecessary to go into the details of developments made on these various properties, as there is nothing outside of the ordinary course of opening up by test shafts, drifts and tunnels to record. On seven of the principal of these prospects there were expended over $35,000, and several operators have gone so far as to bring machinery to their aid for hoisting and pumping.

A correspondent, writing from Port Arthur, says:

" By far the most important find was that of the Lily of the Valley in Paipoonge. The discoverer, Henry Parsons, had taken up the property as a homestead and got some residents of Port Arthur to find money to make good his title to mineral rights, &c., by conceding them a half interest. The surface showing of native silver was wonderful, and is still, after development, though this silver changed to argentite at ten feet in depth, which is quite to be expected. The vein is four feet wide, and is in the slate formation. It reminds one of Rabbit Mountain vein, from having swamp land on each side, so that one cannot trace it far. The location is lot 19, concession II. in Paipoonge township. The vein has been found in exploration in lot 20 by F. Guerard and F. E. Gibbs."

The producing mines have employed forces ranging between ten and sixty men, amounting in all, according to the returns, to 154, exclusive, of course, of a large number indirectly connected with these activities.

About the methods of opening up the mines and the extraction of ore, there is nothing novel. The veins not being, as a rule, wide, the drifts take in the entire vein and stoping is done where the ground warrants it. The most extensively exploited and completely equipped mines are the Beaver and Badger, which are the only ones having the shafts fitted with cages running on tracks. The ore is carried in cars direct from the shutes, run into the cage and hoisted to the surface. The other mines hoist simply with a bucket running on skids.

The present system of treatment of the ore is by wet concentration. The ore, as it comes from the stamps, is graded by separators into three grades, coarse, fine and slimes. These three grades pass over

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* For map of district see part H, vol. III., Annual Reports, Geological Survey of Canada.

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three "Frue" vanners, and thence over three "Hooper" tables, which have a canvas belt twice the width of the rubber belts of the "Frue" vanners, differing also from them in having neither side nor end shake, the necessity for which is got over by an ingenious method of perfect distribution of water and pulp. The pitch of the travelling belt can be readily altered and the machine is said to do excellent work, the cost of treating a ton of ore having been largely reduced by its adoption. The inventor of these tables is Mr. Thomas Hooper, manager of the Beaver Mine, and they are in use both in that mill and in that of the Badger Mine. Besides the six vanners there is also another "Hooper" vanner to treat the slimes very rich in argentite which pass the separators and come direct from the stamps. This does very effective work and the concentrates obtained are very rich.* Though there is much native silver it cannot be economically handled by amalgamation, and there is, therefore, no necessity for pans and settlers such as were first tried in the district. The native silver is all found in the concentrates from the vanner which receives from the coarse separator. The capacity of the mill at the Beaver Mine is twenty to twenty-five tons per day. The product of the mines is shipped in the condition of concentrates produced as above, except a proportion of rich ore requiring no treatment previous to shipment, which, according to returns, amounted this year to from thirty-eight to forty per cent of the whole shipments. Most of this was sold to the smelters in Newark, N.J., a small percentage going to Omaha, Neb.

As to the cost of production, no very close figures can be obtained. The mining cost will, of course, vary with the particular conditions of the various mines, and especially in those veins where the ore is so apt to run in bunches, and where the amount of drifting and sinking to open up any body of ore, varies so much. The cost of concentration is said to be about 90 cents per ton, smelting charges, $12 to $15 per ton of concentrates, and freight of same to Newark, N.J., $14 per ton. From the Rabbit Mountain group of mines to the Canadian Pacific Railway at Murillo costs about $3.75 for cartage. It is said that ore assaying $8 per ton will pay.

The gold-bearing veins of the Thunder Bay district have received but little attention. Discoveries were reported from the Aticokan district. Mr. Smith, of the Geological Survey, during his field work, visited the gold location on the lake west of Manitou Lake and collected some specimens from the veins, of which he says:—

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* We are indebted to Mr. Arthur McEwen, Assoc. R. S. M. and manager of the Shuniah Weachu mine, for much useful information about the latest developments in the Port Arthur silver districts about the method of concentrating as at present carried on.

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"The field appearance is very encouraging; one vein in particular seems to be a very strong one, and in some places is as wide as ten feet, of promising looking quartz, associated with soft, soapy talc schist, in soft chlorite schist."

NORTH-WEST TERRITORIES, &c.—The gold credited to the North-west Territories, &c., resulted from the washing of the gravels of the Saskatchewan River and the Yukon River districts.

For information regarding the former we are indebted to Superintendent A. H. Griesbach, in command of the North-west Mounted Police at Fort Saskatchewan. Some seventeen miners were engaged at times during the three summer months washing the gravels of the River Saskatchewan, between Fort Saskatchewan and Edmonton, and for some distance above and below these two places. There being no means of getting actual figures owing to the desultory nature of the work, a close estimate was obtained by inquiry among the miners and striking an average.

With regard to the Yukon district the same remarks apply. Several estimates were available, and by comparing these, the figures adopted have been arrived at, which, of course, represent only that proportion which there is reason to believe was obtained on Canadian territory, and ignoring that which was obtained from the same river and its tributaries, but over the Alaskan border.

British Columbia.

BRITISH COLUMBIA.—In British Columbia the work of developing the various classes of deposits of the precious metals continued throughout the year in the several districts with varying success.

The yield of gold from shallow placer mining continues to fall off, but more attention is being paid to hydraulic mining of old river channel gravels and prospecting for and working veins.

The chief field of this latter activity is still found in the districts of East and West Kootenay, in the south-east corner of the province, where the numerous discoveries of the last two years, of veins of argentiferous and auriferous galena and copper sulphurets continue to receive attention.

Development work on the claims of the older mining camps such as Toad Mountain, Ainsworth, Trail River, &c., has been continued, and important and promising new discoveries have been made in the district between the Kootenay and Slocan lakes, constituting the new Kaslo-Slocan districts.

Altogether the prospects of these two districts are very bright, the only drawback being the want of a really good railroad and local markets for the ores.

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Following the policy adopted in the past, the record of development and discovery is completed by reproducing below, the details given in the report of the Minister of Mines for the province.

*Cariboo—(Mr. Bowron's Report.)*

"In view of the fact that there has been an actual decrease in the number of men employed, and that several projects of considerable magnitude have been inaugurated, which naturally absorb a portion of the available labour supply, it is satisfactory to note that there has been no decrease in the total gold output of the district for the season.

"Several enterprises of magnitude have been entered upon during the season, from some of which great expectations are anticipated, and, I think, justly so. A visit to the hydraulic claims of the South Fork of the Quesnelle River (to which discovery I referred in my last report) but confirms the impression already expressed, that the finding of a large blind river channel in the hill is one of, if not the most important discovery ever made in placer mining in the province.

"I found the South Fork Company, which is composed principally of working miners, had their large ditch cut some five miles, a large reservoir constructed; also a No. 1 monitor, and some 400 feet of steel pipe (fifteen inches diameter) on the ground, and were prosecuting their work with vigour. Having expended $20,000 in preparation during the summer the company will be ready for piping next season.

"I speak of this company thus particularly to show the confidence reposed in these mines by representative miners.

"I found here also, although unavoidably prevented from visiting personally their mines, that the Victoria Hydraulic Company, under Mr. J. Hepburn's management, had constructed a ditch (having a capacity of 1,500 inches) a distance of seven miles, bringing the water from Spanish Lake to their mines near the South Fork Lake, having during the year expended, including the purchase of plant for saw-mill, $30,000. This company will also be in readiness to commence operations next season. The other companies holding leases of mining ground in this vicinity have so far done but little work, presumably from lack of sufficient capital, although efforts are now being made to secure this necessary acquisition. The new road from the 150-Mile House into the Forks will be a great factor in the development of these mines, as a large quantity of machinery is now lying at the 150 ready to be brought in.

"I am pleased to report the probability of the deep ground on lower Williams Creek being worked next season on an extensive scale, with

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the latest and most approved appliances, by which the gravel will be raised into flumes by hydraulic pressure.

"A London syndicate, at the instance of Mr. A. D. Whittier, of Victoria (who had obtained a lease of ground), sent this spring an expert to examine the property, and whose report appears to have been satisfactory, as Mr. Whittier has since bonded a number of the claims adjoining his leased ground, and is now in England making final arrangements to commence operations.

"The company represented by Mr. Chas. Ramos, who last season obtained a lease of mining ground on Slough Creek, has not as yet commenced operations on the ground.

"It is reported that boring machinery, by which means it is intended to prospect the ground, has been purchased by this company, and is now on its way to Cariboo.

"The introduction of boring apparatus will be a new feature in Cariboo, and one which, it is believed by many who are acquainted with the operating of such appliances, will prove an important factor in the development of our deep diggings.

"Our district was visited this fall by a Monsieur Sampson, at present of Vancouver, but recently from Eastern Canada, the patentee of a machine for saving fine gold. His *modus operandi* is to immerse the appliance in a strong current and allow the sand and gravel containing fine particles of gold to pass over it, the machine catching the gold in transit. Mr. Sampson is very sanguine that there is a "bonanza" in Cariboo for him, but it was too late in the season for him to make a practical test, so he returned to Vancouver for the winter, intending to revisit Cariboo in the spring. Mr. Sampson appears to have good backing, and should his apparatus do half he claims for it, the millions existing in the sand bars and benches of our numerous small streams, to say nothing of the bars of the Fraser, will become a known factor in the general output of the district.

"In the Williams Creek polling division there is but little of especial interest, if I except the proposed working of lower Williams Creek by hydraulic pressure above referred to. At the upper end of Williams Creek, above the old works, Messrs. Taylor and Boyce have opened up a new hydraulic claim, which I understand presents most favourable indications for developing a channel in the hill.

"The Waverly Company, of Grouse Creek, are much gratified at the result of their season's work, the claim having yielded about twice the amount of any previous year, which shows that they are now coming into the paying gravel that the company has so long struggled

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to reach, and there can be no doubt that this claim will give good returns for the next quarter of a century.

"Messrs. Knott, Dibby & Co. obtained a lease of ground on lower Antler Creek, with the purpose in view of again attempting to bottom the deep ground, but so far they have not succeeded in enlisting sufficient interest in the undertaking to warrant them in making a start, but hope to do so during the winter.

"On Lightning Creek a lease of mining ground (which includes within its limits the ground formerly owned by the old South Wales Co.) was obtained by a company of local miners, who have been prosecuting the work of development uninterruptedly during the season.

"Mr. St. Laurent, of Quesnelle, reports the discovery this season of gold in paying quantities, by a party of Chinese miners, on a large creek, a tributary of Quesnelle River, which flows into that stream some 20 miles from its mouth on the north side. The creek is from 20 to 30 miles in length, and five Chinese, working about five miles from its mouth, took out about $2,000 during the season. As this creek has not been visited by whites since this discovery of gold, I cannot speak definitely as to the importance of the find.

"The Blue Lead Hydraulic Mining Company, of Hixon Creek, have prosecuted their works of development during the season, but from last accounts had not reached the bottom of the deep channel in the hill.

"The total gold product of the district, exclusive of Omineca, for the year, I estimate at $195,000, distributed as follows :—

| | |
|---|---|
| "Barkerville polling division, to 15th Nov., per statistics.. | $ 63,450 |
| "Lightning Creek " " " .. | 33,850 |
| "Quesnelle mouth " " " .. | 30,600 |
| "Keithley Creek " " " .. | 57,100 |
| "Estimated product from 15th Nov. to 31st Dec.... ...... | 10,000 |
| Total......... ... .. .................. .. | $195,000 |

"Quartz mining during the season has remained almost in *statu quo*. Indeed, a fatality seems to follow every effort made to develop this most important branch of our mining industry in Cariboo. That we have numberless valuable gold-bearing lodes traversing the district in all directions, none, I think, who are acquainted with recent development, will be inclined to doubt; but it now would appear to have become a settled fact that until better means of communication are provided with the outer world, and consequent improved facilities for the reduction of our ores, little real progress will be made.

"A number of instances might be cited where foreign capitalists about to invest largely in our mines, upon learning that they were

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situated some 300 miles from railway or steam-boat communication, at once abandoned the project. The erection of test works by the Government, in this district, it was hoped would be sufficient to give an impetus to quartz mining, and that these works have met expectations in so far as the treatment of ore is concerned, none will deny. Then why have those wealthy persons and companies, non-residents of the district, who hold valuable mineral claims in Cariboo, ceased development work and left it to a few impecunious miners (who have spent their all, perhaps, in the effort) to develop this industry? Because they are awaiting railway connection, when the further development of their mines will be less expensive. This is the only reasonable conclusion when we consider that three companies now hold charters for the construction of railways to or passing through this district. It is, therefore, important that the Government and Legislature, in considering any project affecting the building of a railway to Cariboo, will make construction at the earliest possible moment a *sine qua non* to any concessions granted.

"The Black Jack Quartz Mining Company is the only company which has during the season done anything to further develop our mineral resources. This company has sunk to the depth of 125 feet, and after running 75 feet of a drive through exceedingly hard rock, finally struck the ledge again, but too late in the fall to fully prove its value at the depth mentioned. The vein here, as far as developed, is about five feet in width. As the work during the season was all in bed-rock, their small mill was not started. Having proved the continuance of the ledge downwards, it is probable this company will, in the spring, start on the 70-foot level to take out and work the ore in their small mill, and have the sulphurets worked at the Government test works.

"Messrs. Martin, McArthur & Co. located and worked a mine on Island Mountain this fall, which is likely to prove valuable. The ledge is about 12 feet in width, assays $25 per ton, and is nearly all free gold. The vein has been traced several hundred feet.

"Mr. Perkins, on Burnes Mountain, continues to work his man-power arrastra, and manages to make his living from it while prospecting the mine.

*(Mr. Stephenson's Report.)*

"The estimated yield of gold for Keithly, Alexandria, and Williams Lake Polling Divisions, Cariboo District, during 1891, is a little less than last year, which can easily be accounted for when we take into consideration the amount of work that has been carried on in this vicinity in the way of digging ditches, and other work where miners or others, whether whites or Chinese, could get employment at good wages. These works, to my certain knowledge, absorbed a considerable number of the Chinese miners in this section. Also, owing to a light snowfall last winter, the hydraulic claims had a shorter season than usual; still, for other kinds of mining, the low stage of water was advantageous in many cases in this section.

"Our old mines in the creek bottoms and along the shallow benches are getting about worked out, and it is to hydraulic mining that we will chiefly have to look for our output of gold in placer mining for the future, and there is every reason to believe that the immense gravel deposits which are to be found along the rivers and creeks in this section of Cariboo will amply repay those who have the capital and enterprise to invest in hydraulic mining. So far, every hydraulic mine that has been opened in this section has proved good paying property.

"On the South Fork of the Quesnelle River, there are two companies—the Victoria Hydraulic Mining Company and the South Fork Hydraulic Mining Company—which, during the past season, have been pushing their works ahead as fast as it was possible for them to do, in the way of digging ditches and other work necessary to the opening up of their hydraulic mines, and, owing to the nature of the country they are operating in, both companies have certainly done a great deal of work for the season. The Victoria company has now something over seven miles of ditch, five feet wide on the bottom, seven feet wide on top, by twenty-four inches deep. This ditch brings the water from Spanish Lake upon the ground they are going to work, on Coquet Lake, at the lower end of Quesnelle Lake. This company has other locations, which they intend opening as soon as it is possible to get the necessary work done. During the season they have employed, upon an average, a force of ten whites and fifty Chinese. Their works are well advanced, and early next season they expect to be in full operation. The South Fork company have about five miles of their ditch completed. Their ditch is four feet wide in bottom, six feeet on top, by twenty-two inches deep. This part of their ditch is through a very rough country, a great deal of blasting and rock cutting having been done to avoid fluming. They have also completed a large reservoir, which will enable them to use their hydraulic pipe ten hours out of the twenty-four just as soon as they can get ready. This they expect to be able to do during the coming season. This company, dur ing the season has employed, upon an average, ten whites and thirty-five Chinese, and will continue to push their work as fast as possible until they get their mine opened. Both these companies will have an ample supply of water during the whole mining season when their ditches are completed and in working order.

"On Keithley Creek, two Chinese companies have hydraulic claims which are paying them well, although they are only just getting them opened. Two other Chinese companies on the same creek are also preparing for hydraulic workings, thus showing that the banks and benches on Keithley Creek will well pay for hydraulic mining.

"On Snowshoe Creek there are now two good hydraulic claims, the well-known Anderson & Smith claim and the Hayward Company claim, which is principally owned by Messrs. Veith & Borland, on Keithley and Snowshoe creeks. There are still several claims working in the bed of the creek by wing-damming, and getting to the bed-rock at a low stage of water.

"On Snowshoe Creek, there has been a company of whites at work for a year past in trying to get to the bottom of the creek. They have sunk an eighty-foot deep shaft in the bed-rock, and the last time I heard from them they had drifted from the bottom of their shaft one hundred feet in the bed-rock towards the channel, but had not yet broken through. It is to be hoped they will find enough gold to repay them well for the work done. Over this channel lies a great depth of slum, and all attempts to sink a shaft through it have proved failures, but the company now going through the bed-rock will, in all probability, succeed in getting to the bottom of the channel.

"Harvey Creek is now abandoned by white men; the last company left lately, after having worked out what paying ground they could find. There are now three Chinese companies on the creek, working over old ground.

"The company of whites (three) on Spanish Creek still continue to drive their tunnel ahead. They are getting a little gold, but have not yet reached the old channel where they expect to find good pay.

"On the North Fork of Quesnelle River there is very little mining being done at present, only one white man working on the river and a few Chinese. The former is driving a tunnel, and the latter working along the river.

"Kangaroo Creek empties into the North Fork about two miles above the Forks of the Quesnelle. This creek, in former years, paid well on the surface for a distance of two miles up from the river, but it has never yet been bottomed in the deep ground, although several parties have tried to sink shafts upon it. Last year, Mr. Theodore Thermahlon obtained a lease of one-half mile of the creek. He tried

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to sink a shaft, but was driven back by water. He then started a tunnel, and is now in about three hundred feet, and he thinks he will probably have to go three hundred feet more to find bottom. Two men have been employed at this work for over a year. On the main branch of the Quesnelle River, from the Forks down, nothing of any importance is being done; there are only a few Chinese miners scattered along the river engaged in desultory mining.

"On the South Fork River, outside of the two companies previously mentioned (the Victoria and South Fork), there is nothing new to report. The two Chinese hydraulic claims have done as well as usual, considering the very poor supply of water during the season. They depend for their water supply upon the small streams upon which they are located. Other work done on the river has been by Chinese during very low water in the winter and early spring, when they get as far out in the river bottom as they possibly can, sometimes by wing-damming. They also work from a raft, with very long handled shovels, bringing up what little dirt they can and rocking it out upon the raft. Very little work of this kind has been done for the last two years; it is evident they cannot make it pay now, or they would not abandon it.

"On the Horsefly River, in the Harper claim, now worked by Mr. R. T. Ward, some very good paying ground has been discovered during the season, and they have good prospects for the future, but the company will be put to considerable expense to get the ground in working order. Five miles further down the river from the Harper claim the Discovery Company have been operating their hydraulic claim with fair results, although their supply of water was light during the summer. At this place, two other companies have been driving in tunnels to reach the old channel, but have not yet got through the rimrock.

"Along the Fraser River, in my section, there is nothing new to report for the season. The few hydraulic claims (four) keep working, while the desultory mining has been carried on about as usual.

"As to quartz mining, or even prospecting, I have nothing to report, as there has been nothing whatever done anywhere in this section that I am aware of."

### *West Kootenay—(Mr. Fitzstubbs's Report).*

"The mining industries of West Kootenay district, consisting chiefly of quartz mining, have progressed satisfactorily during the past season, and well-grounded hopes exist of continuous improvement.

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Discovery and development —British Columbia.

"The following statement of records shows the transactions in the respective divisions :—

| | |
|---|---|
| "*Revelstoke Division*— | |
| Locations | 73 |
| Assessment certificates | 25 |
| "*Nelson Division*— | |
| Locations | 416 |
| Assessment certificates | 75 |
| Transfers | 251 |
| "*Trail Creek Division*— | |
| Locations | 87 |
| Assessment certificates | 33 |
| Transfers | 46 |
| "*Ainsworth Division*— | |
| Locations | 363 |
| Assessment certificates | 113 |
| Transfers | 179 |
| "*Goat River Division*— | |
| Locations | |
| Assessment certificates | |
| Transfers | |
| [Not obtainable.] | |
| "*Summary*— | |
| Locations | 939 |
| Assessment certificates | 246 |
| Transfers | 476 |

"From the above statement it appears that prospecting has been prosecuted vigorously, chiefly in the Nelson and Ainsworth divisions.

"About 200 of the above location records are in portions of the district, namely, on the Slocan and Kaslo streams, which heretofore have been visited only by stray prospectors.

"The above statement shows, also, a satisfactory proportion (considerably larger, I believe, than hitherto) between the number of locatio made and the number of assessment certificates issued; and further that buyers of mineral claim prospects have been unusually active.

"Development work, in the sense of work to prove and not merely t hold the mine, has not been lacking, though no mine in the district i as yet, fully worked with adequate capital and labour invested in th hope of realizing dividends, but the high offers made, and high price paid, or agreed to be paid, for promising prospects, together with th steady work undertaken by claim owners, on their own well know

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claims, in the Toad Mountain, Ainsworth, Trail, Goat River, and Illecillewaet camps, indicate that there soon will be in the district mines worked systematically on a large scale, some of which, no doubt, will become dividend-paying properties.

"I regret that I am unable to report any considerable exports of mineral products from the district, though there is a good deal of ore on the dumps. Various circumstances connected with the principal high grade 'shipping ore' claims have prevented the export of their products during the past season.

"Silver lead ore of medium grade constitutes a large proportion of the mines in West Kootenay, and for this class of ore it has been found difficult to obtain a profitable market. The high freight rates and difficulties of transportation, together with the duty of $30 per ton on lead ores, recently imposed by the United States, make unprofitable the shipment of any lead ore that averages less—so the opinion seems to be at Ainsworth—than about $80 per ton. Claim holders, nevertheless, and mining men generally, believe strongly in the future, and have not been slow in spending their money in support of their opinions. There will probably soon be a home market for the above class of ores.

"The lead smelter already existing at Revelstoke, in the northern part of the district, is to be supplemented by the erection in the southern part of an 80-ton smelting and refining plant, with a concentrator of 100 tons a day capacity. These works are now in course of erection at Pilot Bay, on Kootenay Lake. They are owned by a wealthy American company, which already has large mining property in Kootenay. The enterprise will, undoubtedly, have a most beneficial effect on the lead mining of the section. The promoters have planned so as to permit the increase of capacity, and the treatment of all kinds of ores in the works, when required.

"Some of the companies whose claims are what miners call 'concentrating propositions,' propose, in the coming season, to erect concentrators at their mines, to prepare the ore for shipment.

"The above gives a general view of the condition of mining in the district. I have now to state, more particularly, what is being done at the different camps.

"The quartz leads at Big Bend are at present neglected. Two placer companies are at work there, one on French Creek, with four men, and one on the west shore of the Columbia River, above Smith Creek, with five men. Both pay good wages.

"At Illecillewaet, the only continuous work is upon the Lanark claim, which is the property of the Lanark Consolidated Mining and Smelting Company. Their work, it is confidently expected, will be

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successful, and have the effect of aiding the progress of this valuable well placed camp, towards which attention is again directed. Several claims have been located along the upper waters of Fish Creek, above the Falls. Some of the prospectors who have been across the divide, in the neighbourhood of Trout Lake, express themselves in favourable terms as to the mineral appearance of parts of that country. It is a part of the Revelstoke division which may repay further prospecting.

"No important find has been made in the country along the Arrow Lakes during the past season.

"Several mineral claims have been located at Sproat, which have yielded gold and silver, but the assays, so far, have not been very attractive.

"The camp at Trail has advanced this year in public favour. The principal leads are of silver-bearing copper ore, yielding also gold. There is also silver-bearing galena ore. The leads are very extensive, and the quality proves to be higher than was at first supposed. About 30 men have been at work in this camp. The Le Roi Mining Company, an active Spokane concern, has an 82-feet shaft, and a tunnel 130 feet. Assessment, and also some development work, has been done on other claims. The size of the leads and the presence of quantities of ore that will pay to 'matte,' are encouraging facts. Assays and returns have been satisfactory. The return from a ten ton shipment averaged $86 per ton.

"In what is known as the 'free gold belt,' in this camp, several claims yield fine specimens of free gold, and the owners believe that further work will disclose defined ledges of paying gold ore. The supposed superior attractions of Slocan as a newer field, may draw men thither during the coming season, but the camp at Trail, no doubt, has an assured future. On the upper waters of Sheep Creek, which flows southerly across the boundary, several gold-bearing quartz claims have been recorded.

"The prospecting of the 'Whitewater' gold mine, near Rover Creek (south of the River Kootenay, about half-way between Nelson and Robson), has been satisfactory to the owners, and will be continued with more suitable appliances.

"The stamp mill on the 'Poorman' group of gold claims, near 49 Creek has not been actively at work lately, for reasons not adverse, it is believed, to the character of the claims. Assessment, and in some cases additional work, has been done on other gold claims in that neighbourhood. The extensive copper deposit on the north side of the River Kootenay, in this quarter, continues to attract attention.

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"On Toad Mountain, prospecting, also assessment and developing work, have progressed steadily. Ordinary prospect claims have been in demand, generally, at fair prices.

"A high price—it is said over a million dollars—was offered during the autumn for the well known group of claims owned by the Kootenay Bonanza Company, but was not accepted. On one of these claims, the 'Silver King,' the tunnel is now in over 700 feet, and cross-cuts show abundance of fine ore. There appears to be about 500 tons of picked ore, probably worth several hundred dollars a ton, on the dump at this mine. The development work undertaken on the adjacent promising groups of claims, owned respectively by the Stadacona Mining Co. and the Helena and 'Frisco Mining Co., has been steadily prosecuted, I believe, to the satisfaction of these important companies, which are prepared to work their mining properties on an extensive scale, as soon as their value has been thoroughly proved. On a number of claims owned by individuals and private companies, the necessary assessment work, and also developing work, has been done. Confidence in the future of this established camp has been much strengthened during the past season.

"In the Salmon Valley, between Toad Mountain and the boundary, several promising leads exist, on which sufficient work has been done to warrant good hopes for the future.

"I am pleased to be able to report, further, that several gold placer claims on Hall Creek, in the above locality, have yielded, during the summer, good wages to the locators, who propose to continue to work.

"The Ainsworth, or Hot Springs camp, which is essentially a silver lead camp, has much more than maintained its repute. Comparatively few claims have been allowed to lapse, and on nineteen well known claims considerable development work has been done in excess of the required annual expenditure. The transfers represent over a quarter of a million dollars. The Pilot Bay Smelting Works, already mentioned, will help this camp importantly, by affording a needed local market for ores. The largest amount of development work, during the past season, has been done on the properties of the Revelstoke Mining Co., McCune Co., of Salt Lake City, Ashworth & Jevons, of Billings, Montana, Howe & Co., of Duluth, and Dr. Coe, of Seattle. More than 2,000 feet of shafts, tunnels, etc., have been sunk or run during the past season in this camp.

"A shipment of 200 tons of ore produced an average of $150 a ton at Helena, Montana; and another shipment of ten tons realized $600 a ton at Tacoma. Pumping and hoisting plants, chiefly of American manufacture, have been erected at four of the mines. In one case, a

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30-horse power plant was procured in Toronto, with the exception of the pump, which, I am informed, could not be obtained in Canada. It is proposed to erect concentrators at several of these mines during the coming season. There are over 3,000 tons of ore on the dumps, some of it of very high grade.

"The extensive and valuable claims in the Hendryx camp, on Kootenay Lake, opposite Ainsworth, where about seventy claims are located, on some of which a great deal of development work has been done during the past season, will be greatly enhanced in value by the effect of the Pilot Bay Smelting Works, now in course of erection by Dr. Hendryx and his associates.

"Considerable attention has been directed to the twenty or thirty mineral claims which have been located in the vicinity of Goat River and Duck Creek, tributaries to Kootenay River, in the Goat River District. The ore, so far, does not appear to be high grade, but is in sufficient quantity to be regarded as promising. An American company proposes to undertake development work on some of their claims in this locality during the ensuing season.

"About sixteen and twenty-five miles, respectively, north of Ainsworth, on the west side of Kootenay Lake, on Kaslo and Schroeder creeks, valuable discoveries of lead and copper ore have lately been made, and eighty locations recorded. Owing to the lateness of the season, at the altitude of these discoveries, little development work has been done as yet on any of the claims, but the assays generally give a very high percentage of silver. The last advices confirm the existence of large bodies of silver, lead, and copper ores, in this section.

"Some of the prospectors on the Kaslo River, who proceeded westerly across the divide, made further very important discoveries of mineral claims on the Slocan slope, toward the close of the season. These lie, for the most part, from ten to fifteen miles easterly from the Slocan Lake, but claims have been located on the eastern margin of the lake. The existence of minerals in this region has been known for some years. The mines appear to be in the limestone belt, which Dr. Dawson noticed as running south-easterly from about the foot of Upper Arrow Lake. The discoveries were made so late in the fall that I was unable to visit the locality. The ores, so far as known, consist chiefly of silver-bearing galena and carbonates, but some of the ores have copper for a base. The assays on an average run high. Twenty assays ranged from low grade to 2,000 ozs. per ton, the average being about $175 a ton. As the prospectors had only a few weeks available before winter set in, it is difficult for any one at present to give a complete account of these discoveries. No work, of course, has been done on the claims. The

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prospectors, however, judging from surface showings, express a very favourable opinion as to the mineral character of the region. They say that large bodies of ore exist, and that access to the region, and the natural mining conditions, are favourable.

"That this opinion is generally entertained by prospectors, and by mining men generally, is attested by the number of records made, and the number of claims which, without any work being done on them, have been bought by investors. About fifty men, it is said, are wintering in Slocan. Storekeepers, packers, and steam-boat men, have arranged their business for a large influx of persons into the Slocan country in the spring. The people of Nelson have cut out a twenty-five-mile trail from the Columbia and Kootenay Railway to Slocan Lake. The probability is that a large number—possibly a very large number—of miners and others will be attracted to West Kootenay in the early part of the year, by these Slocan discoveries.

"So far as I can judge of a population, which as in all mining districts, is liable to much fluctuation, it probably somewhat exceeds 2,000, nearly all engaged in or dependent on mining. A considerable number of families have settled in the district."

### *East Kootenay—(Mr. Cummins's Report).*

*Placer Mining.*—"The total value of gold derived from placer mining during 1891 amounted to $28,500.

"The creeks from which the gold was taken all lie in the southern portion of the district.

"The hydraulic workings of Mr. David Griffith on Wild Horse Creek, which yielded last year about $9,000, have, I understand, not been in continuous operation this year, pending negotiations respecting the sale of the property to an English company.

"I am glad to be able to state that it is proposed to test the deep ground on Wild Horse Creek. Some efforts were made in this direction over twenty years ago without success. The scheme has, however, been thought well of by good authorities on placer mining, and there is every reason to suppose that the ground is rich. A lease of one and a half miles of the bed of the creek has been granted to a company of ample means to carry on the work in a most efficient manner.

"The greater part of the placer gold derived from the various creeks, as will be seen by the tabular statement, was taken out by Chinese companies."

*Quartz Mining.*—"Mineral development in this district has, during 1891, been carried on with more energy than heretofore. Capital de-

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rived from outside sources has been invested in the district, and is being expended in the development of some good prospects, under competent direction, in various localities. Work is going on steadily this winter on several properties, and satisfactory results may be looked for before spring. Assessment work has also been done with greater regularity and intelligence than heretofore. The possibility of now bonding or selling mineral claims has also led the discoverers to make greater individual effort in prospecting their claims. It may now, I hope, be fairly said that mineral development has commenced, and that progress will be more rapid during next year. Search for new discoveries has not been so active, most of the prospectors having been engaged in working on their claims. A few good prospects have, however, been found, especially in the southern portion of the district.

"Another feature to be mentioned is that the assays of mineral obtained from claims throughout the district show a marked increase in richness. As erroneous ideas have in some cases been formed, due to the results published in some of the reports of the Geological Survey, of specimens which happen to have reached Ottawa from time to time,* I add, at the conclusion of this report, a list of assays obtained through the courtesy of Mr. Harvey, of Golden, which are perfectly reliable, and which confirm the fact that the ores of the district are mainly high grade in character, and in some instances run very high in both gold and silver.

"The trails and roads have been kept in a state of efficiency, owing to the liberal appropriations devoted to their improvement and repair last session.

"It is to be regretted that no funds were available during the summer for the collection of samples from the ore deposits of East Kootenay, as a very handsome exhibit could have been collected, at a moderate cost, to represent the mineral of the district for exhibition. the effect produced by the very fine exhibits of West Kootenay having resulted in great advantage to that district, and having been a credit to all concerned.

"The 'Bobby Burns' claim, situated near the head of the Middle Fork of the Spillemechene or McMurdo Creek, mentioned on page 373 of the Report of the Minister of Mines for 1890, has attracted much attention during the season. A five-stamp gold quartz mill was erected on the ground last summer. The water power was, unfortunately, not got into working order before the coming on of the winter. It is, however, expected to be in operation early next season.

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*The results so given are accurate, for the *specimens* received by the Survey, but unless these are collected by competent and reliable persons, nothing can be guaranteed as to how far they represent the *average* of the ore body from which they come.

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"Some development done on the lead since the date of last year's report established the existence of a considerable quantity of free milling gold quartz on the surface, the quantity in sight justifying the erection of machinery, To what depth the lead will maintain its free milling qualities has not yet been conclusively tested. It is considered that at a depth a large quantity of gold will be contained in sulphurets, in which case it is assumed that additional plant will be needed. It seems highly probable that the enterprise, with experienced and practical management, will pay handsomely, and prove the forerunner of similar undertakings in the near future on other gold ledges which exist in the immediate neighbourhood.

"Development prosecuted, for a time on a considerable scale, on the property of Messrs. Rand Bros.' Syndicate, on Carbonate Mountain, on the right bank of McMurdo Creek, has been temporarily suspended whilst organizing a larger company, which has lately been registered as the Carbonate Mountain Mining Company, Limited. It is understood that the company will prosecute development vigorously in the spring. As mentioned in last report, this property was reported on favourably in 1889 by Mr. Giffard, the expert, well known in connection with the undertakings of Messrs. John Taylor & Son, of London.

"On the opposite side of the creek, directly to the north-west of Carbonate Mountain, little more than assessment work has been done. Some of the claims are, however, reported to be showing very favourably.

"But little work has been done on the Copper Creek claims.

"Further to the south-east, on the left bank of Vermont Creek, a tributary of the South Fork of the Spillemechene River, three claims were bonded last autumn to the management of the Golden Smelting and Mining Company. A contract was let in the beginning of the winter to the owners of the claims for two hundred feet of tunnelling and cross-cutting. According to the last information received, a tunnel had been run into the face of the mountain in a north-westerly direction for one hundred feet, and a cross-cut to the right commenced.

"The Vermont claim, one of a block of claims situated on the southern side of Vermont Creek, mentioned on page 374 of last year's report, has been steadily worked all this winter. The greater portion of the ground included in this block was bonded to Messrs. Osler & Hammond, of Toronto, last summer, after being examined in their interests by Mr. George Attwood, the expert and mining engineer, on whose report, and according to whose directions, the present work is being carried on, under the charge of a qualified mining engineer.

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"As stated in last year's report, this property contains a number of veins of silver-bearing galena and grey copper ore on the surface, ten of which, varying from six inches to twenty inches in width, are confined to a comparatively small area on the Vermont claim. A tunnel is being driven to cut those veins in the mountains, at a depth of about two hundred feet from the surface, to test their permanence, and ascertain to what degree they converge or run together to form larger veins at that depth. The tunnel has been driven in three hundred feet up to the date of last reports. At two hundred feet a vein was cut which does not appear in the face of the mountain. It was expected to cut some of the principal veins in the early part of January, and news is now shortly expected.*

"It has been estimated, from the surface showings of the veins, that their strike is about N. 65° W. and S. 65° E., with a dip varying from 50° to 80° southward. The veins all cut the formation in dip, and gain in strength as they attain depth in the mountain, generally pinching as they approach Vermont Creek. Some cannot be traced in the face of the bluff.

"The average of eighteen samples taken indifferently from the surface of the veins by Mr. Attwood, assayed silver, 86.013 ounces; lead, 41.83%; whilst many high assays have been obtained at various times by the owners of the claims, the highest of which I am aware giving 1,169 ounces of silver to the ton.

"The claims on the south-eastern side of the divide between Vermont Creek and Crystal Creek would appear to contain extensions of the Vermont Creek veins. A tunnel of forty feet has been driven this winter on one of these claims, and good concentrating ore found in a vein of some size, which has all the characteristics of a true fissure.

"The mineral claims lying further south in this belt, many of which were noticed in last year's report, have not been developed to any extent beyond doing assessment work last season. There are, however, some promising prospects on Bugaboo Creek, Horse Thief Creek and Toby Creek, which will, it is hoped, attract the attention of those possessing the capital to develop them in the near future, should ventures going on in neighbouring localities prove successful.

"The claims on Jubilee and Spillemechene Mountains, lying near the foot of the Selkirks in the Columbia Valley, near the mouth of the Spillemechene River, have not been worked this year beyond the usual assessment work. Crown grants have been obtained for several claims,

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* "Since the above was written, news of a very favourable kind has been received. At about three hundred and twenty feet in the tunnel, a vein reported to be three feet in thickness was cut. This is probably the first of the veins showing on the surface. The assays of the ore are stated to be most satisfactory.

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and the issuing of grants for others, delayed through litigation, now happily overcome. It is understood that a considerable amount of capital would be needed to develop the mineral of this locality effectively. Most of the properties are, however, with reason, considered valuable.

"The work which was being carried out last winter on the Spillemechene claim, alluded to in last year's report, brought to light some fine bodies of galena ore, which were considered to be of too low grade in silver to be profitably worked in the existing state of the lead market. It may, however, be reasonably expected that higher grade ore will be met with, as good assays have been obtained from the same lead.

"Thunder Hill is a large butte situated in the foot-hills of the Selkirk Range, near Findlay Creek, and within about one and a half miles of the Upper Columbia Lake, on which a number of claims have been located.

"This discovery was made by Mr. James Brady, M.E., in 1884. Until this winter, but little development work was done on any of the claims. The work done from year to year was confined mainly to cutting trenches across the butte at various places, in order to locate the lead, which was, to a great extent, covered with soil.

"During the latter part of last summer, Mr. Brady formed a company, registered as the Thunder Hill Mining Company, Limited, of Victoria, to test and operate his claims. Work has been prosecuted in a most energetic manner this winter. The lead is of exceedingly large dimensions, running in a northerly and southerly direction. The country rock of the locality appears to be generally Cambrian slate.

"I have not had the advantage of examining the property since last fall, when the operations of the company were about to commence. The following particulars have, however, been obtained from several reliable sources:—

"The work done this winter consists of an open cut, about one hundred and fifty feet in length, running across the lead. The top width is about twenty feet, the average depth about eighteen feet. This cut has disclosed large quantities of concentrating ore, silver and gold-bearing galena, with some gray copper. The quartz, in some instances, contains a small quantity of free gold. The ore taken out of the cut has been stored for future treatment.

"It is understood that, should developments continue as promising, the proprietors intend to put up concentrating works on a very large scale, as, to judge from present showing, the supply of ore would seem to be almost unlimited.

"The mine is exceptionally situated for operating at an exceedingly low cost. A tramway, not more than two miles in length, will connect

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with the Upper Columbia Lake, and the transportation facilities of the Upper Columbia Navigation and Tramway Co. The mill site would probably be located on or near the lake.

"On Windermere Mountain, situated about four miles north of Windermere, on the Lower Columbia Lake, work has not progressed as rapidly as was anticipated last spring. A ten-ton lot of ore taken from the principal claim was sold in the early part of the summer for $50 a ton to complete a shipment from elsewhere. The Windermere Mining Co., Ltd., was organized at Spokane to work this claim, and a contract for 50 feet of drifting was let last fall.

"The Canal claim, on the east side of the Upper Columbia Lake, has been recently sold for $3,000, but little work had been done on the claim. It is understood to be a very good prospect.

"In the valley of the Kootenay River, and in the adjacent Hughes' Range of the Rockies, a number of claims have been recorded. From reports received, there are sufficient grounds to look forward to this locality receiving more attention in the future.

"On Wild Horse Creek, some claims have been staked on old discoveries in the neighbourhood of the Old Camp.

"The Pass claim, on the mountain above Wild Horse, is, I understand, showing favourably. In the vicinity of this lead a small stringer was discovered last summer. A little pocket in this seam, which is situated on the mountain, far above the action of water, contained over $100 worth of gold. The remainder of the seam, as far as it was explored was barren. This would tend to confirm Dr. Dawson's opinion as to the origin of the Wild Horse placers.

"In last year's report the discovery of a new district was alluded to, on Lost Creek, in the Rockies, about eleven miles in a south-easterly direction from Fort Steele, from whence some high grade samples of ore were obtained. About two miles further down the creek two leads were discovered last summer, containing peacock copper ore of remarkably beautiful appearance. When I visited the claims there was a very fine display of ore in the face of the workings on one of the leads.

"The original discoveries, further up the creek, from which assays of 800 ounces to the ton in silver and $46.60 in gold were obtained, have not been prospected sufficiently yet to determine the permanence of the veins, which are small at the surface. There is, however, a probability that further discoveries will be made in the locality, as the formation is very favourable, and larger leads should exist.

"The Monarch mine, which was being actively worked during the beginning of the year, has closed down for the present. I am not acquainted with the exact reasons which led to this. The other claims near Field have only had the necessary assessment work done this year.

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"Some new discoveries, which are stated to be of importance, have been made up the Ottertail Creek. The claims nearer the Canadian Pacific Railway track have not been worked.

"Howse Pass.—Discoveries were made in the early part of the season in the neighbourhood of the head waters of the Bow River. Doubts exist if they are in British Columbia or the North-west Territories.

"The Golden Smelting Works are now in complete order, and I understand the management intends to make an effort to obtain sufficient ore for a run shortly.

"The following is a statement of a number of assays obtained from claims in different localities in the East Kootenay District previously referred to :—

"LIST OF ASSAYS OBTAINED FROM EAST KOOTENAY ORES IN 1891.*

| Date. | Locality. | Mineral. | Assays to the Ton (2,000 lbs.) |
|---|---|---|---|
| 1891. | | | |
| September. | McMurdo Creek..... | Quartz. ..... | Gold $326.70. |
| June.. . | do ...... | do ...... | Gold 15.43 oz. |
| do ...... | do ..... | do ...... | Gold $546.30. |
| do ... | do ..... | do ....... | Gold $34.35. |
| do ...... | do . . . | Galena... .. | Silver 41.45 oz., lead 79%. |
| do .. .. | do .... | do . . . . | Silver 177.29 oz., lead 74%. |
| July....... | Copper Creek......... | do ....... | Silver 102.9 oz., lead 69%. |
| do ...... | Vermont Creek.. . | Grey copper. | Silver 1169.33 oz. |
| do ...... | do .. .. .. | ............. | Silver 242.39 oz., gold $5.38. |
| do ...... | do (average of 18 samples from surface of various leads.) | Galena and antimonial copper. | Silver 86.01 oz., lead 41.83%. |
| do .... | Crystal Creek......... | ........ | Silver 50.05 oz. |
| do ..... | do ........ | ........ | Silver 1,113 oz. |
| do ...... | Bugaboo Creek....... | ........ | Silver 249.66 oz. |
| do ...... | do ....... | ........ | Silver 61.97 oz., gold nil. |
| do .... | Jubilee Mountain. ... | Copper ores... | Silver 129.91 oz., gold nil. |
| do . .. | Howse Pass..... .... | ......... | Copper 12.7%, silver 38.23 oz., gold 19 dwt. |
| June..... | Windermere.. ..... ... | ......... | Lead 46.7%, silver 38.75 oz., gold $23. |
| May. .. . | Ottertail.. .......... | ........... | Silver 19.25 oz., gold $3.25, lead 60%. |
| do ..... | East Kootenay....... | ....... .. | Silver 111.28 oz., gold $35.15. |
| do ...... | do ........ | ........... | Silver 107.79 oz., gold $1.25. |
| do ...... | North-west of Golden. | Antimonial c'r | Silver 72.01 oz., gold $14.62. |
| do . . | East Kootenay.. ...... | ........ .. . | Silver 80 oz., gold $50. |
| do ...... | Windermere.......... | ... ... .... | Silver 43.99 oz., gold $1. |
| do ...... | Lost Creek.. .. .. .... | ........... ... | Silver 71.16 oz., gold $46.60. |
| November. | do ..... ..... | Grey copper.. | Silver 610.58 oz., gold $7. |
| do .. | do ... ...... | do .. | Silver 800.18 oz., gold $19.62. |
| do .. | Skookum Chuck ..... | Antimonial ore | Silver 523.52 oz. |
| do .. | Hughes' Range....... | ... ....... | Silver 44.50 oz., gold $1. |
| do .. | North-west of Donald. | Copper ore.. | Silver 243.95 oz. |

*It is not clear whether the assays made were of picked *specimens*, of material taken hap-hazard, or of carefully selected *samples* representing the average of some definite ore body. The usefulness of the results as illustrating the mineral capabilities of the district are thus greatly lessened.

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"In conclusion, I beg to state that 253 free miners' certificates have been issued during the year, the number of new claims recorded being 138."

*Lillooet—(Mr. Soues's Report.)*

"The total yield of gold for the year (ascertained from reliable sources only) is $52,506.

"This shews a decrease of nearly $19,000 as compared with the ascertained yield of last year.

"This decrease does not infer by any means that the sources of supply are exhausted, but is attributable simply to the fact that the Chinese miners, for reasons best known to themselves, have almost deserted this district for the past two years.

"Considering the few miners there are in the district, and with the knowledge that several of the white miners, this year at least, have been non-producers, and the fact that there has been no new or rich strikes, I must confess to being surprised that the returns are so large.

"The various gentlemen to whom I am indebted for courteous information as to the amounts of gold dust bought by them during the year, kept a correct business account of their gold-buying transactions, and knowing them all for many years, I have every confidence that their statements to me are absolutely correct.

"The aggregate of their figures give the above-named total. I make no calculations or allowances from any other source of information.

"Mr. Phair, Mining Recorder at Lillooet, reports to me under date 26th inst. : 'The yield of gold for the season for 1891 in this part of the district is $39,091. This amount was shipped to San Francisco, through the Bank of British Columbia, by the following, viz. :—

| | |
|---|---|
| 'A. W. Smith | $22,399 |
| 'C. A. Phair | 10,500 |
| 'A. McDonald | 6,192 |
| | $39,091 |

"'You will observe the yield is smaller than usual, owing entirely to the departure of nearly all the Chinese to work on the railroad and on the mining ditches on the South Fork of Quesnelle River. The amount taken out by the Lillooet Hydraulic Mining Company, viz., $6,192, is good considering the fact that two months of the working season were lost while enlarging ditches and flumes and opening out a new cut, otherwise they would have taken out considerably more.

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The company intend during next season to dig a new ditch four and a half miles to the 4-Mile Creek, and, when completed, it will give them double the water they now have. This mine is splendidly equipped for working by the superintendent, Mr. A. McDonald.

" ' This company has also a lease on the South Fork of Bridge River which prospects exceedingly well. They commenced mining this season with a large force of men, but their wing-dam, unfortunately, was carried off by high water. They are replacing it this winter. The Mina Company, on Tyaugton Creek, have completed their flume and ditch and will commence mining in the spring. Their ground shows good prospects. Mr. Jensen, representing a Victoria company, intends to commence active operations under their mining lease on Cadwallader Creek as soon as the season opens.

" ' The Vancouver Enterprise Mining Company, on Cayoosh Creek, have their tunnel in now over 500 feet, and expect to have it finished in three months.

" ' A scheme is being developed for bringing water from Cayoosh Creek upon the benches on both sides of the Fraser River at Lillooet. If this were accomplished it would add greatly to our prosperity.'

" With regard to the scheme to which Mr. Phair refers, viz., bringing in water for hydraulic mining purposes from Cayoosh Creek, two mining leases have been granted and three more applied for, all dependent on water from this creek. The supply is more than ample for all, and available at all seasons. For hydraulic mining, possibly during the months of December, January and February, at intervals on account of frost, it might be necessary to shut off the water, otherwise work would be continuous, and there is no question as to the results. Were proof wanting as to the mineral value of the various benches in the immediate neighbourhood of Lillooet, we have it in the returns from the Lillooet Hydraulic Mining Company and Messrs, Peters & Ward's mining leases. With a most inadequate supply both of these enterprises are doing very well, and at least settle the question as to what could be done with a powerful and well managed supply of water. Cayoosh Creek is the only source from which this supply can be had, and to bring it in sufficiently high to cover all the available benches will be a most costly undertaking, and I can only trust that the parties interested will carry out the scheme as they propose on a large and substantial plan. Hydraulic mining with any of the other small creeks in that neighbourhood is only time lost, for the inevitable small returns.

" In view of probable extensive hydraulic mining on the various benches of the Fraser River in this district in the near future it is, THE PRECIOUS METALS. Discovery and development—British Columbia.

perhaps, not out of place here to refer to a similar method of mining in other lands, notably on the Feather, Yuba and Sacramento rivers in the State of California, where legislative action was invoked to put a final stop to it on account of filling up the rivers named with silt, and the practical destruction and flooding of unnumbered acres of, probably, the best alluvial lands in that state.

"From personal observation, I am clear in saying the same conditions do not exist here, and capitalists investing largely in substantial, permanent works for the conveyance of water for hydraulic mining purposes, in this district at least, need not take into consideration the probability in the near or remote future of being met with legislative enactments or judicial injunctions compelling them to stop work.

"Of the leases issued last year, so far there are no returns, bringing in a sufficient supply of water, being the great and expensive barrier in every case."

*Quartz Mining.*—"In quartz mining I regret to say that I have absolutely nothing new to report.

"A number of mineral claims recorded in 1889 and 1890 have been practically abandoned, no work or prospecting having been done on them in the past year. On Cayoosh Creek sufficient work was done on the Bonanza Company's property in the early part of the year in compliance with the latter part of clause 73, 'Mineral Act, 1884.' Negotiations for bonding the above-named property, and two other locations on the same creek, by English capitalists have been in progress for some time, but up to the present no satisfactory terms have been concluded.

"Prospecting work on most of the locations on the North Thompson has been done during the year, notably by Messrs. Allingham, Craven and McDonald. The whole of the miners in this part of the district are heavily handicapped by the innumerable natural obstacles in their way—remoteness from all centres of supply, total absence of roads or trails, and dangerous and rapid rivers to cross, all in combination with a very short season.

"The scheme for working Big Bar on the Fraser River, under water, by machinery, referred to in my report of last year, came to an abrupt ending early in the season. The large scow for carrying the dredging plant was jammed in the ice and carried off before any practical work was done.

"I understand the company propose building another scow this winter to be ready for active work at lowest water in the early spring.

### *Yale—Kamloops Division—(Mr. Tunstall's Report).*

THE PRECIOUS METALS. Discovery and development —British Columbia.

"After giving particulars of work and discovery in iron and copper deposits, Mr. Tunstall says:—'Placer mining on the Tranquille River is pursued on so small a scale as not to be worthy of mention, and, I regret to add, I cannot report any operations in the gold or silver-bearing veins in this division of this district.'"

### *Yale—Yale Division—(Mr. Dodd's Report).*

"A few of the bars on Fraser River, from Hope to Foster's Bar, have been worked by Chinese in a desultory manner. It is, however, impossible to obtain any reliable data as to their success, as most of their earnings (presumably small) are sold in small quantities to the various traders in the district.

"An English syndicate commenced operations on Hill's Bar Flats in April last, by washing the banks by means of a powerful Merriweather hydraulic pump, and continued work until the end of September, when, expectations not having been realized, work was discontinued for the season, after a large outlay for machinery and labour.

"Yale Creek.—The owners of the Queen Mine have been actively at work all the season. Operations at this mine commenced in 1878, and up to the present time nearly 2,500 feet of tunnels have been driven, the last 100 feet giving indications of a very favourable character.

"Siwash Creek.—Placer Mines.—Rodney & Co. have wing-dammed the creek, laid a flume 450 feet long, 4 feet wide and 2 feet deep. They have also run a race, having expended during the past season, $1,800. They have not reached bed-rock, but are washing a fine body of gravel 16 to 18 feet deep, out of which was washed 20 oz. of gold, including one piece valued at $45.

"Siwash Creek syndicate, composed of a few of the leading men of Vancouver, obtained a lease of the lower end of the creek, and began work in a practical manner about two months ago by constructing a dam and sluice gate across the creek, laying a flume 135 feet long, 5 feet wide and 2 feet deep, blasting down two falls and sluicing to a depth of 22 feet. Very encouraging prospects have been found and I trust to be in a position in a few months to report that very good pay has been discovered.

"Roddick & Co. have also obtained a lease of a portion of the creek near the Forks, on which active operations will be under way as soon as the spring opens.

THE PRECIOUS METALS. Discovery and development —British Columbia.

"About 20 quartz claims are located on Siwash Creek, on a large portion of which assessment work has been performed, with the exception of the Montrose and Roddick. On the latter several thousand dollars have been expended in driving tunnels, discovering such encouraging prospects of free gold, that a Crown grant has been applied for. This mine will be thoroughly tested by a company of Vancouver capitalists.

"Two leases have been applied for adjoining the Boston Bar farm by the side of the old wagon road. So far, the lessees are busy testing the ground by sinking a series of prospecting shafts on the land.

"Before closing my report I would respectfully submit, for the consideration of the Government, the urgent necessity of constructing a pack trail into Siwash Creek, as the only mode of transporting tools and supplies is packing by Indians, at a cost of four cents per pound. This, of course, would be greatly reduced in the event of a suitable pack trail being constructed."

### *Yale—Okanagan Division—(Mr. Deudney's Report).*

"Two whites and a few Chinese are still prospecting Cherry Creek, and the Chinese are taking out small wages from the abandoned claims.

"Mr. John Merritt, foreman of the Cherry Creek Mining Company, is still persevering in trying to find the old channel. The tunnel now extends about 800 to 850 feet, with very good indications ahead. He showed me from 4 to 6 oz. of coarse gold, which he took out from his last two or three sets of timbers.

"Mr. L. W. Riske and Donald McIntyre have during the summer been working their quartz mines on the Monashee Mountain, with good results, until compelled to shut down for want of water. They now intend to bring water, as proposed last year, a distance of two and a half miles, by ditch and flume, which will give them an ample quantity to operate the mill during the summer months.

"A very little prospecting on Rock Creek, and at the quartz mines, has been done during the summer, and until better facilities are offered for getting machinery into the province there will still remain a deadlock in mining enterprises.

"The placer and hydraulic mines at the mouth of Rock Creek have not done so well this past season, the output of gold reaching only from $5,000 to $6,000.

"Very encouraging reports come from Fairview Camp, and I am informed that it is a most promising camp, several claims having already been bonded for large sums, but, for lack of machinery, they have not been thoroughly tested.

"There are one or two hill claims on Siwash Creek, the owners of which are developing their prospects by tunnelling."

### *Yale—Similkameen Division—(Mr. Hunter's Report).*

"The yield of gold still continues to decrease, although the yield of platinum has increased considerably, both in quantity and value.

"On Granite Creek the yield of gold has increased, five companies are on fair pay, averaging about $6.50 per day.

"On Newton Creek very little work has been done, the water having given out, although while it lasted fair wages were made.

"On Slate Creek a large amount of work was done, considering the few miners there. In most cases fair wages were obtained. This creek has proved to be rich, though only a small portion of it has been worked, on account of the ground being so deep and miners not being in possession of funds to prospect it.

"On Boulder Creek there is only one Chinese company, and they have obtained small wages.

"On the Tulameen River a large amount of work has been performed, principally mining for platinum, the price of which has increased, making it an object to mine solely for that metal.

"An hydraulic company has been started on the Tulameen, about fifteen miles north-west of Granite Creek. The work is being pushed forward with all speed. A saw-mill, with a capacity of 25,000 feet per day, has been erected on the ground. The company expects to have the machinery in working order this fall, so as to be able to start up in the spring.

"About twenty Indians were mining on this river, with rockers, and obtained small wages.

"On the Similkameen, mining operations have been limited this year, the late season having kept the river high, and a scarcity of hands obliged Mr. Allison to shut down on his claim.

"On Whipsaw Creek very little work was done, on account of the small wages obtained.

"Considerable work has been done this year in quartz mining.

"About nine miles from Princeton, and about five from Friday Creek, a claim has been located, although little work has been done on it as yet.

"On the Bonanza Queen and Nevada, situated on the Tulameen River above Granite Creek, the owners have satisfied themselves with merely performing the necessary work to hold the location."

## PYRITES.

PYRITES. Production, etc.

The amount of pyrites or sulphur ore produced in Canada during 1891 was 67,731 tons, valued at $203,193. This was all used in the manufacture of acid. As this ore runs from 35 to 40 per cent of sulphur, it will represent about 25,542 tons of sulphur.

QUEBEC.—As formerly, the whole of the pyrites produced is the result of the working of the Capelton group of mines near Sherbrooke. Of the operations at these points there is nothing new to add to the description given in last year's report.

Messrs. Nichols & Co. have continued to use part of their ore on the spot in the manufacture of sulphuric acid, shipping the bulk of it, however, in the raw state for similar use in their acid works at Laurel Hill. The remainder was also shipped to United States to acid manufacturers, the much enhanced price of sulphur causing a demand for pyrites to replace the more expensive article.

The effect of this demand is visible in the figures of production, which as compared with last year's, viz., 49,227 tons, show a great increase.

There being as yet slight demand for sulphuric acid in Canada the value of the country's resources in the way of pyritous sulphur ores varies with the fluctuations in the price of the competing material, viz., sulphur, and is closely connected with supply and demand in the American markets for this material.

The main feature of the American market would seem to be that the great increase in the price of sulphur has forced upon many acid makers the necessity of altering their works, and replacing their sulphur burners by furnaces suitable for burning pyrites. The effects of this movement will affect also the future policy of those acid makers who have previously adhered to the use of sulphur, even possibly at some disadvantage, rather than go to the great expense of constructing the much more elaborate plant for using pyrites. These, however, having once incurred this expense will for that very reason continue to be users of the pyritous ores.

It must be remembered, however, that whilst these changes will affect the *relative* values of all Canada's pyrite deposits, many will yet be without the pale of profitable working, on account of their inaccessibility and lack of cheap means of transport to the consumers and must await the improvement of these conditions or the creation of a local demand by the erection of acid works in their vicinity.

In regard to this latter point the needs of the phosphate industry may at some future time lead to the manufacture of acid in those min-

Pyrites.

ing districts themselves and to a consequent demand for pyritous deposits within a reasonable distance.

The subjoined table shows that the home market for sulphur increases slightly but steadily year by year :—

Imports of Sulphur.

### Pyrites.

### Table 1.

### Imports : Brimstone or Crude Sulphur.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880........ ..... ..... | 1,775,489 | $27,401 |
| 1881........ ......... | 2,118,720 | 33,956 |
| 1882........ ......... | 2,375,821 | 40,329 |
| 1883..................... | 2,336,085 | 36,737 |
| 1884 ..................... | 2,195,735 | 37,463 |
| 1885..... ..... ...... | 2,248,986 | 35,043 |
| 1886..................... | 2,922,043 | 43,651 |
| 1887..... .. ...... | 3,103,644 | 38,750 |
| 1888..................... | 2,048,812 | 25,318 |
| 1889..................... | 2,427,510 | 34,006 |
| 1890..................... | 4,440,799 | 44,276 |
| 1891..... ............ | 3,601,748 | 46,351 |

## SALT.

Salt.

### PRODUCTION.

Production, etc.

During 1891 there were 45,021 tons of salt sold, valued at $161,179 ; this production is altogether that of the provinces of Ontario and New Brunswick, and the result of operations carried on by the following producers :—

| | |
|---|---|
| Courtwright ............. | Courtwright Salt Company. |
| Parkhill................. | Hutchins & Company. |
| Port Franks............. | Jos. Williams. |
| Exter.................... | Exeter Salt Works Company. |
| Hensall........... ..... | Geo. McEwen. |
| Clinton.. ................ | R. & J. Ransford. |
| " .................. | John McGarva. |
| Goderich ................ | N. A. Chemical Company. |
| " ................. | Ogilvies & Hutchison. |
| " ................. | Peter McEwen. |
| " ................. | Jos. Kidd, jr. |
| " ................. | John S. Platt. |
| Warwick................. | Elarton Salt Works Co. |
| Wingham ............... | Grey, Young & Sparling Co. |
| Blyth................... | " " |

SALT.
Production, etc.

Kincardine...............L. Rightmeyer.
"  ...............Ontario People's Salt Co.
Brussels.................T. T. Coleman.
Sarnia..................Sarnia Salt Co.

The quantity of salt produced this year is 1,267 tons in excess of last year, while the value has decreased $37,718. According to returns annually received at this office the production for the past five years has been as follows:—

1886—62,359 tons, valued at.............. $227,195
1887—60,173 " " .............. 166,394
1888—59,070 " " .............. 185,460
1889—32,832 " " .............. 128,547
1890—43,754 " " .............. 198,897

There is nothing new to report in the industry, beyond the fact that a new company, the Sarnia Salt Company, began operations at a new block erected in Sarnia.

Exports and Imports.

The following tables, 1, 2 and 3, and graphic table A, illustrate the exports and imports during this and previous years, and explain themselves:—

### SALT.

### TABLE 1.

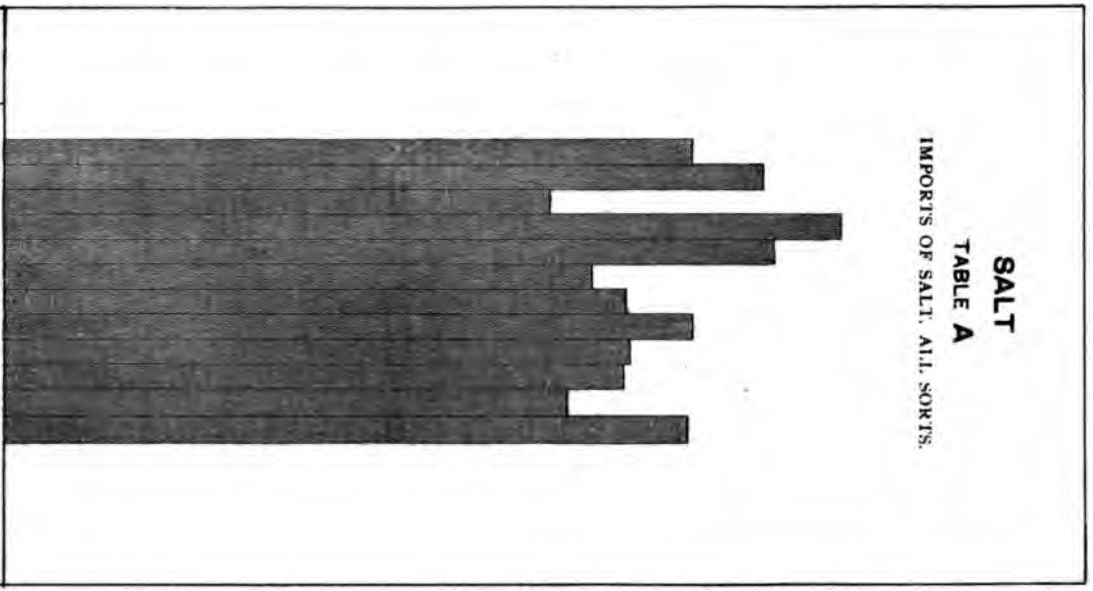
### EXPORTS.

| Year. | Bushels. | Value. |
|---|---|---|
| 1880........ | 467,641 | $46,211 |
| 1881........ | 343,208 | 44,627 |
| 1882........ | 181,758 | 18,350 |
| 1883........ | 199,733 | 19,492 |
| 1884........ | 167,029 | 15,291 |
| 1885........ | 246,794 | 18,756 |
| 1886........ | 224,943 | 16,886 |
| 1887........ | 154,045 | 11,526 |
| 1888........ | 15,251 | 3,987 |
| 1889........ | 8,557 | 2,390 |
| 1890........ | 6,605 | 1,667 |
| 1891........ | 5,290 | 1,277 |

GEOLOGICAL SURVEY DEPARTMENT OF CANADA
ALFRED R. C. SELWYN, C. M. G. LL. D., F. R. S. DIRECTOR.

PLATE XI.

| Fiscal Year | Tons |
|---|---|
| 1880 | 106,720 |
| 1881 | 117,115 |
| 1882 | 84,932 |
| 1883 | 129,442 |
| 1884 | 119,081 |
| 1885 | 90,984 |
| 1886 | 96,236 |
| 1887 | 106,728 |
| 1888 | 97,338 |
| 1889 | 96,019 |
| 1890 | 86,813 |
| 1891 | 105,316 |



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**SALT.**
**Exports and Imports**

### SALT.

### TABLE 2.

### IMPORTS: SALT PAYING DUTY.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880 | 726,640 | $ 3,916 |
| 1881 | 2,588,465 | 6,355 |
| 1882 | 3,679,415 | 12,318 |
| 1883 | 12,136,968 | 36,223 |
| 1884 | 12,770,950 | 38,949 |
| 1885 | 10,397,761 | 31,726 |
| 1886 | 12,266,021 | 39,181 |
| 1887 | 10,413,258 | 35,670 |
| 1888 | 10,509,799 | 32,136 |
| 1889 | 11,190,088 | 38,968 |
| 1890 | 15,135,109 | 57,549 |
| 1891 | 15,140,827 | 59,311 |

### SALT.

### TABLE 3.

### IMPORTS: SALT NOT PAYING DUTY.

| Fiscal Year. | Pounds. | Value. |
|---|---|---|
| 1880 | 212,714,747 | $400,167 |
| 1881 | 231,640,610 | 488,278 |
| 1882 | 166,183,962 | 311,489 |
| 1883 | 246,747,113 | 386,144 |
| 1884 | 225,390,121 | 321,243 |
| 1885 | 171,571,209 | 255,719 |
| 1886 | 180,205,949 | 255,359 |
| 1887 | 203,042,332 | 285,455 |
| 1888 | 184,166,986 | 220,975 |
| 1889 | 180,847,800 | 253,009 |
| 1890 | 158,490,075 | 252,291 |
| 1891 | 195,491,410 | 321,239 |

## STRUCTURAL MATERIALS.

**STRUCTURAL MATERIALS.**
**Building Stone**

*Building Stone.*—According to direct returns received at this office, and estimated to constitute about four-fifths of the total production, there were 187,685 cubic yards produced, having a net value at the quarries of $708,736, showing a decrease, compared with 1890, of $256,047. The production, as returned to this office for the year, by provinces, is shown in the following table:—

STRUCTURAL MATERIALS.
Building Stone.

### STRUCTURAL MATERIALS.

### TABLE 1.

### PRODUCTION OF BUILDING STONE DURING 1891.

| Province. | No. of Returns | Cub. Yds. | Value. |
|---|---|---|---|
| Ontario.................. | 55 | 127,548 | $426,908 |
| Quebec.................... | 26 | 45,353 | 202,319 |
| Nova Scotia.............. | 10 | 2,650 | 28,037 |
| New Brunswick........... | 7 | 8,767 | 41,838 |
| British Columbia.......... | 1 | 150 | 1,600 |
| Manitoba.................. | 1 | 44 | 600 |
| North-west Territories...... | 3 | 3,173 | 7,434 |
| Totals............ | 103 | 187,685 | $708,736 |

Returns received in a similar manner show the production for the past five years to have been as follows:—

1886—165,777 cubic yards................$642,509
1887—262,592 " ................ 552,267
1888—411,570 " ................ 641,712
1889—341,337 " ................ 913,691
1890—382,563 " ................ 964,783

Of the operations throughout the Dominion, but little need be said, as work was carried on on lines very similar to those of last year. Of the work in New Brunswick, Mr. H. P. Brumell reports on two of the largest quarries there as follows:—

"The Dorchester Union Freestone Co. are carrying on active operations at Rockland, Westmoreland Co., N.B., where they are turning out very large dimension stone. The stone is olive-coloured and the section in the quarry shows about thirty-five feet of red sandstone, breaking into small blocks on account of the jointing. Beneath this is found the olive stone sought for, having a thickness of thirteen feet. This lower bed is very solid and free from fractures or mud planes. All shipments are made by water and about two-thirds the output goes to the United States. Prices are:—Small and random blocks, $4 per ton, F.O.B.: large dimension stone, $8.50 to $9, F.O.B.

"The New York Freestone Quarrying Co. are operating at Wood Point, and from the quarry opened there about five years ago, they obtain a micaceous sandstone which on drying, becomes almost grey, with a reddish tint. The quarry face shows the following section: thin upper beds, three to ten feet in all; lower bed thirty feet, between mud planes. The equipment at the quarry is very complete, consisting of steam drills and hoisting gear and cable tramway to landing,

STRUCTURAL MATERIALS.
Building Stone.

m whence the stone is taken on scows to Sackville for transportation rail.

"This and all the larger quarries of New Brunswick are being erated on the 'notch' system, thus ensuring cleaner blocks and less ual dead work."

The following tables of exports and imports explain themselves:—

STRUCTURAL MATERIALS.

TABLE 2.

EXPORTS OF STONE AND MARBLE, WROUGHT AND UNWROUGHT.

| Province. | 1890. | | 1891. | |
|---|---|---|---|---|
| | Wrought. | Unwrought. | Wrought. | Unwrought. |
| ntario | $ 7,284 | $ 6,474 | $1,804 | $23,311 |
| uebec | 53 | 1,613 | .......... | .......... |
| ova Scotia | 252 | 16,821 | 300 | 12,793 |
| ew Brunswick | 13,649 | 11,275 | 9,105 | 9,323 |
| Ianitoba | .......... | 9 | .......... | .......... |
| ritish Columbia | 487 | 7,419 | 2,189 | 735 |
| Totals | $21,725 | $43,611 | $13,398 | $46,162 |

STRUCTURAL MATERIALS.

TABLE 3.

IMPORTS OF BUILDING STONE.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $ 35,970 |
| 1881 | 58,149 |
| 1882 | 33,623 |
| 1883 | 35,061 |
| 1884 | 51,088 |
| 1885 | 30,491 |
| 1886 | 41,675 |
| 1887 | 54,368 |
| 1888 | 86,373 |
| 1889 | 100,314 |
| 1890 | 132,155 |
| 1891 | 170,890 |

STRUCTURAL MATERIALS.
Building Stone.

### STRUCTURAL MATERIALS.

### TABLE 4.

### IMPORTS OF MANUFACTURES OF STONE OR GRANITE, N.E.S.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $29,408 |
| 1881 | 36,877 |
| 1882 | 37,267 |
| 1883 | 45,636 |
| 1884 | 45,290 |
| 1885 | 39,867 |
| 1886 | 41,984 |
| 1887 | 41,829 |
| 1888 | 47,487 |
| 1889 | 61,341 |
| 1890 | 84,396 |
| 1891 | 61,051 |

During 1891 Canada afforded a market for about $880,000 worth of building stone, as follows:—

| | | |
|---|---|---|
| Production | $708,736 | |
| Imports, building stone | 170,890 | |
| Imports, stone and granite | 61,051 | |
| | | $940,677 |
| Less—Exports, wrought stone | 13,398 | |
| Exports, unwrought stone | 46,162 | |
| | | 59,560 |
| | | $881,117 |

Marble.

*Marble.*—The production of marble for 1891 shows a considerable falling off when compared with the year previous, as the amount produced was only 240 tons, valued at $1,752, a decrease of 540 tons. The following figures show the production for the past five years:—

| | | |
|---|---|---|
| 1886—501 | tons, valued at | $9,900 |
| 1887—242 | " | 6,224 |
| 1888—191 | " | 3,100 |
| 1889— 83 | " | 980 |
| 1890—780 | " | 10,776 |

No new developments have come within the knowledge of the Division; the production is that of quarries which have been operated for many years.

STRUCTURAL MATERIALS. Marble.

The following table 5 shows the imports for the past twelve years and explains itself:—

STRUCTURAL MATERIALS.

TABLE 5.

IMPORTS OF MARBLE.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $ 63,015 |
| 1881 | 85,977 |
| 1882 | 109,505 |
| 1883 | 128,520 |
| 1884 | 108,771 |
| 1885 | 102,835 |
| 1886 | 117,752 |
| 1887 | 104,250 |
| 1888 | 94,681 |
| 1889 | 118,421 |
| 1890 | 99,353 |
| 1891 | 107,661 |

Granite

*Granite.*—There is a slight increase shown in the figures of production of granite, the amount quarried and sold this year being 13,637 tons, valued at $70,056, as against 13,307 tons, valued at $65,985 for 1890.

By provinces the production was as follows:—

| | | | |
|---|---|---|---|
| Ontario, | 3,842 | tons | $ 9,451 |
| Quebec, | 4,425 | " | 17,390 |
| Nova Scotia, | 1,130 | " | 3,415 |
| New Brunswick, | 4,240 | " | 39,800 |

The annual production for the past five years is shown below:—

| | | |
|---|---|---|
| 1886—6,062 | tons, valued at | $ 63,309 |
| 1887—21,217 | " | 142,506 |
| 1888—21,352 | " | 147,305 |
| 1889—10,197 | " | 79,624 |
| 1890—13,307 | " | 65,985 |

STRUCTURAL MATERIALS.
Slate.

*Slate.*—Only one slate quarry was in operation during the year, viz., that owned by the New Rockland Slate Company, whose return on account of its confidential character, is withheld. The only figures available, therefore, are those of exports and imports given below:—

### STRUCTURAL MATERIALS.

### TABLE 6.

### EXPORTS OF SLATE.

| Year. | Tons. | Value. |
|---|---|---|
| 1884 | 539 | $6,845 |
| 1885 | 346 | 5,274 |
| 1886 | 34 | 495 |
| 1887 | 27 | 373 |
| 1888 | 22 | 475 |
| 1889 | 26 | 3,303 |
| 1890 | 12 | 153 |
| 1891 | 15 | 195 |

### STRUCTURAL MATERIALS.

### TABLE 7.

### IMPORTS OF SLATE.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $21,431 |
| 1881 | 22,184 |
| 1882 | 24,543 |
| 1883 | 24,968 |
| 1884 | 28,816 |
| 1885 | 28,169 |
| 1886 | 27,852 |
| 1887 | 27,845 |
| 1888 | 23,151 |
| 1889 | 41,370 |
| 1890 | 22,871 |
| 1891 | 46,104 |

Flagstones

*Flagstones.*—The production of flagstones for 1891 amounted to 27,300 square feet, valued at $2,721, an increase over 1890 of 9,435 square feet and $1,078. The production is altogether that of quarries in Wolfe and Richmond counties, in the province of Quebec.

STRUCTURAL MATERIALS.
Flagstones.

During the past five years the production has been as follows :—

| | | |
|---|---|---|
| 1886— | 70,000 (?) feet | $ 7,895 |
| 1887— | 116,000 " | 11,600 |
| 1888— | 64,800 " | 6,580 |
| 1889— | 14,000 " | 1,400 |
| 1890— | 17,865 " | 1,643 |

No exports of flagstones, as such, were reported. The imports are given in the following table :—

STRUCTURAL MATERIALS.

TABLE 8.

IMPORTS OF FLAGSTONES.

| Fiscal Year. | Tons. | Value. |
|---|---|---|
| 1881 | 23 | $ 241 |
| 1882 | 90 | 848 |
| 1883 | 10 | 99 |
| 1884 | 137 | 1,158 |
| 1885 | 205 | 1,756 |
| 1886 | 1,602 | 9,443 |
| 1887 | 1,316 | 10,966 |
| 1888 | 2,642 | 21,077 |
| 1889 | 1,669 | 15,451 |
| 1890 | 5,665 | 48,995 |
| 1891 | 3,770 | 36,348 |

Cement.

*Cement.*—The total production of hydraulic cement of all kinds during 1891, was 93,473 barrels, having a value of $108,561, showing in quantity a decrease of 8,743 barrels while the value increased $16,156.

For the past four years the production has been as follows :—

| | | |
|---|---|---|
| 1887— | 69,843 brls | $81,909 |
| 1888— | 50,668 " | 35,593 |
| 1889— | 90,474 " | 69,790 |
| 1890— | 102,216 " | 92,405 |

But little can be said of the industry beyond that to be found in last year's report of this division. The operators during the year were as follows :—

| | |
|---|---|
| Imperial Portland Cement Co | Montreal, Que. |
| Thos. M. Morgan | " " |
| T. A. Gauvreau & Co | Quebec " |
| C. B. Wright & Co | Hull " |

STRUCTURAL MATERIALS.
Cement.

| | | |
|---|---|---|
| Napanee Cement Works Co. | Napanee Mills, | Ont. |
| Jas. Marshall | Rymal | " |
| Toronto Lime Co | Limehouse | " |
| John Battle | Thorold | " |
| Isaac Usher & Sons | " | " |
| Irwin, Hopper & Co | Marlbank | " |
| North American Chemical, Mining and Manufacturing Co | Owen Sound, | Ont. |
| Geo. Reid | Hannon | " |

Regarding some operations in Ontario and Quebec, Mr. H. P. Brumell reports as follows:—

"Messrs. Irwin, Hopper & Co., of Montreal, have during the year erected a plant for the manufacture of Portland cement at Cementville Siding, near Marlbank, Hastings county, Ont. The cement will be produced from marl and clay obtained in the immediate vicinity of the works, which have a capacity of thirty-five tons per day. Careful experiments and trials have been made, with the result that the company feel confident that during the coming year they will place upon the market a very superior and strong cement. Tests made —one hour in air and seven days in water—run as high as 550 pounds. It is the intention to ship the product in cotton bags instead of barrels, by which means it is expected the strength of the cement will be better guarded.

"The North American Chemical Mining and Manufacturing Co., of Owen Sound, have erected a plant for the manufacture of Portland cement, at a lake a short distance from Owen Sound, Ont. Two kilns have been erected and put into commission with a capacity of forty-two tons of clinker per kiln per week.

"The lake has an area of about 600 acres, and is in the fall of the year comparatively dry. A section of the lake deposit shows: Marl, two feet; mixed marl and clay, four feet. The materials in proper proportions are first mixed by means of a 'mixer' or puddler, after which the 'mud' is pumped to wet stones and ground, and from thence pumped to dry pans where the waste heat and gases from the attached kilns dry it. After roasting to clinker, the cement is ground in the usual way.

"Works for the production of Portland cement were erected during 1891 by the Imperial Portland Cement Co. at Pointe Claire, Que. Three kilns were erected, and active operations under the management of Mr. Gordon Kingan, at once begun. The materials used in the manufacture of the cement are found in the immediate vicinity of the works and consist of ordinary blue limestone and clay. The propor-

STRUCTURAL MATERIALS.
Cement.

tions of these requisite for the making of a strong cement have been very carefully worked out with the result that the company are now turning out a very superior quality of cement."

The following tables, 9, 10 and 11, illustrate the imports of cement; the exports are included with those of lime in table 14:—

STRUCTURAL MATERIALS.

TABLE 9.

IMPORTS OF CEMENT IN BULK OR BAGS.

| Fiscal Year. | Bushels. | Value. |
|---|---|---|
| 1880 | 65 | $ 28 |
| 1881 | 579 | 298 |
| 1882 | 386 | 86 |
| 1883 | 1,759 | 548 |
| 1884 | 4,626 | 1,236 |
| 1885 | 4,598 | 1,315 |
| 1886 | 6,808 | 1,851 |
| 1887 | 5,421 | 1,419 |
| 1888 | 23,919 | 5,787 |
| 1889 | 32,818 | 10,668 |
| 1890 | 21,055 | 5,443 |
| 1891 | 11,281 | 2,890 |

STRUCTURAL MATERIALS.

TABLE 10.

IMPORTS OF HYDRAULIC CEMENT.

| Fiscal Year. | Barrels. | Value |
|---|---|---|
| 1880 | 10,034 | $ 10,306 |
| 1881 | 7,812 | 7,821 |
| 1882 | 11,945 | 13,410 |
| 1883 | 11,659 | 13,755 |
| 1884 | 8,606 | 9,514 |
| 1885 | 5,613 | 5,396 |
| 1886 | 6,164 | 6,028 |
| 1887 | 6,160 | 8,784 |
| 1888 | 5,636 | 7,522 |
| 1889 | 5,835 | 7,467 |
| 1890 | 5,440 | 9,048 |
| 1891 | 3,515 | 6,152 |

STRUCTURAL MATERIALS.
Cement.

STRUCTURAL MATERIALS.

TABLE 11.

IMPORTS OF PORTLAND CEMENT.

| Fiscal Year. | Barrels. | Value. |
|---|---|---|
| 1880 | | $ 55,774 |
| 1881 | | 45,646 |
| 1882 | | 66,579 |
| 1883 | | 102,537 |
| 1884 | | 102,857 |
| 1885 | | 111,521 |
| 1886 | | 120,398 |
| 1887 | 102,750 | 148,054 |
| 1888 | 122,402 | 177,158 |
| 1889 | 122,273 | 179,406 |
| 1890 | 192,322 | 313,572 |
| 1891 | 183,728 | 304,648 |

Roofing Cement.

*Roofing Cement.*—During the year there was a production of roofing cement of 1,020 tons, valued at $4,810, showing a decrease, when compared with last year, of 151 tons and $1,692.

Lime.

*Lime.*—The production of lime during 1891 shows a slight decrease when compared with the year previous, the quantity being 1,829,894 bushels, valued at $251,215. Full data cannot be obtained, though all the principal producers are thought to have made returns and it is supposed that the above represents four-fifths of the total production.

The production, by provinces, as well as the totals for the past five years, are given in the following tables :—

STRUCTURAL MATERIALS.

TABLE 12.

PRODUCTION OF LIME DURING 1891.

| Province. | No. of Returns | Bushels. | Value. |
|---|---|---|---|
| Ontario | 63 | 1,227,681 | $152,286 |
| Quebec | 9 | 506,700 | 77,462 |
| Nova Scotia | | | |
| New Brunswick | 6 | 67,430 | 15,285 |
| Prince Edward Island | 2 | 6,150 | 1,482 |
| North-west Territories | 3 | 21,933 | 4,700 |
| Totals | 83 | 1,829,894 | $251,215 |

STRUCTURAL MATERIALS.
Lime.

STRUCTURAL MATERIALS.

TABLE 13.

ANNUAL PRODUCTION OF LIME.

| Year. | No. of Returns | Bushels. | Value. |
|---|---|---|---|
| 1886.......... | 87 | 1,535,950 | $283,755 |
| 1887. .. ...... | 133 | 2,269,087 | 394,859 |
| 1888........... | 93 | 2,216,764 | 339,951 |
| 1889........... | 106 | 2,948,249 | 362,848 |
| 1890........... | 93 | 2,501,079 | 412,308 |

The exports of lime and cement and the imports of lime are given the following tables :—

STRUCTURAL MATERIALS.

TABLE 14.

EXPORTS OF LIME AND CEMENT.

| Province. | 1887. | 1888. | 1889. | 1890. | 1891. |
|---|---|---|---|---|---|
| ntario ............ ... | $ 4,269 | $ 12,262 | $ 12,877 | $17,341 | $ 21,924 |
| uebec.............. ... | 83 | 398 | 71 | .......... | 25,729 |
| ova Scotia.. ........... | 142 | 278 | 11,017 | 17,137 | 15,451 |
| ew Brunswick........... | 77,518 | 97,318 | 135,222 | 130,180 | 59,318 |
| rince Edward Island..... | 4 | . ..... .. | 2 | 5 | 12 |
| anitoba... ............ | 241 | .......... | 2,060 | .......... | .......... |
| ritish Columbia.. ..... | 4 | ..... .... | ...... .. | 4,141 | 300 |
| Totals........... | $82,261 | $110,256 | $161,249 | $168,804 | $122,734 |

STRUCTURAL MATERIALS.

TABLE 15.

IMPORTS OF LIME.

| Fiscal Year. | Barrels. | Value. |
|---|---|---|
| 1880............ .. | 6,100 | $ 6,013 |
| 1881.... ..... ....... | 5,796 | 4,177 |
| 1882..... ......... ... | 5,064 | 5,365 |
| 1883..... ..... ...... | 7,623 | 9,224 |
| 1884........ ... ..... | 10,804 | 11,200 |
| 1885 .... .......... | 12,072 | 11,503 |
| 1886............ .. | 11,021 | 9,347 |
| 1887.. ... .... ...... | 10,835 | 8,524 |
| 1838..... .. .. ..... | 10,142 | 7,537 |
| 1889..... .... . .... | 13,079 | 9,363 |
| 1890........... .. ... | 8,149 | 5,360 |
| 1891 ................. | 6,259 | 4,273 |

STRUCTURAL MATERIALS.
Building Bricks.

*Building Bricks.*—The production of building bricks during the year and according to direct returns was 176,533 thousand, valued at $1,061,536, a slight decrease from figures obtained in the same way for the year previous. These returns are not complete but are supposed to represent about four-fifths of the total production.

The production by provinces is as follows :—

STRUCTURAL MATERIALS.

TABLE 16.

PRODUCTION OF BRICKS DURING 1891.

| Province. | No. of Returns. | Thousands. | Value. |
|---|---|---|---|
| Ontario ...... ...... . . | 225 | 166,415 | $675,719 |
| Quebec ................. | 33 | 35,536 | 204,192 |
| Nova Scotia ............. | 11 | 8,825 | 54,755 |
| New Brunswick.... ..... | 11 | 5,145 | 35,725 |
| Prince Edward Island.... | 4 | 830 | 5,720 |
| Manitoba .. .. ......... | 2 | 650 | 6,100 |
| North-west Territories. .. | 5 | 2,050 | 23,000 |
| British Columbia ........ | 7 | 7,082 | 56,325 |
| Totals... .......... | 298 | 176,533 | 1,061,536 |

The total yearly production for the past five years, as returned to this office, is as follows :—

| | |
|---|---|
| 1886—139,345 M., valued at.............. | $ 873,600 |
| 1887—181,581 M. " .............. | 986,689 |
| 1888—165,818 M. " .............. | 1,036,746 |
| 1889—200,561 M. " .............. | 1,273,884 |
| 1890—211,727 M. " .............. | 1,266,982 |

The exports of bricks amounted to 246,000 thousand, valued at $1,163, as follows :—

| | |
|---|---|
| Ontario, 229 thousand...................... | $1,039 |
| Nova Scotia, 14 thousand.................. | 94 |
| Prince Edward Island, 3 thousand............ | 30 |

STRUCTURAL MATERIALS.
Building Bricks.

The following table illustrates the imports of bricks for the past twelve years:—

### STRUCTURAL MATERIALS.

### TABLE 17.

### IMPORTS OF BUILDING BRICK.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $ 2,067 |
| 1881 | 4,281 |
| 1882 | 24,572 |
| 1883 | 14,234 |
| 1884 | 20,258 |
| 1885 | 14,632 |
| 1886 | 5,929 |
| 1887 | 2,440 |
| 1888 | 20,720 |
| 1889 | 24,585 |
| 1890 | 12,500 |
| 1891 | 9,744 |

Terra Cotta.

*Terra Cotta.*—There was a production of terra cotta during the year amounting to $113,103, an increase over the year previous of $23,103. Comparisons with years prior to 1890 cannot be made as returns were not made nor asked for.

Drain Tiles.

*Drain Tiles.*—According to returns made to this office, and supposed to represent about two-thirds of the total output, there were produced in 1891, 11,839 thousand drain tiles, valued at $141,399, an increase over the year previous of 1,318 thousand and $522.

The production by provinces is shown in the following table 18:—

### STRUCTURAL MATERIALS.

### TABLE 18.

### PRODUCTION OF TILES DURING 1891.

| Province. | Number of Returns. | Thousand. | Value. |
|---|---|---|---|
| Ontario | 91 | 11,597 | $136,388 |
| Quebec | 1 | 111 | 1,665 |
| Nova Scotia | | | |
| New Brunswick | 4 | 98 | 1.346 |
| British Columbia | 1 | 33 | 2,000 |
| Totals | 97 | 11,839 | $141,399 |

STRUCTURAL MATERIALS.
Drain Tiles.

For the past five years the annual production has been as follows:—

| | | |
|---|---|---|
| 1886—12,416 M, | valued at | $142,617 |
| 1887—14,658 M | " | 230,068 |
| 1888— 7,518 M | " | 114,057 |
| 1889—10,526 M | " | 134,265 |
| 1890—10,521 M | " | 140,877 |

The imports, if any, are included with those of sewer pipes in table 19. No exports are reported.

Sewer Pipes.

*Sewer Pipes.*—The production of sewer pipes during 1891 was $227300, a decrease, when compared with 1890, of $120,700. No further statistics beyond those of imports are available :—

STRUCTURAL MATERIALS.

TABLE 19.

IMPORTS OF DRAIN TILES AND SEWER PIPES.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $ 33,796 |
| 1881 | 37,368 |
| 1882 | 70,065 |
| 1883 | 70,699 |
| 1884 | 71,755 |
| 1885 | 69,589 |
| 1886 | 57,953 |
| 1887 | 71,263 |
| 1888 | 101,257 |
| 1889 | 83,215 |
| 1890 | 77,434 |
| 1891 | 87,195 |

Pottery.

*Pottery.*—Returns made direct to this office show that there was a production of pottery of all kinds, and earthenware, amounting to $258,844, an increase over last year of $63,602. The returns made to this office are supposed to represent about four-fifths of the total production.

The following table shows the imports for the past twelve years. There were no exports reported :— STRUCTURAL MATERIALS. Earthenware.

STRUCTURAL MATERIALS.

TABLE 20.

IMPORTS OF EARTHENWARE.

| Fiscal Year. | Value. |
|---|---|
| 1880 | $322,333 |
| 1881 | 439,029 |
| 1882 | 646,734 |
| 1883 | 657,886 |
| 1884 | 544,586 |
| 1885 | 511,853 |
| 1886 | 599,269 |
| 1887 | 750,691 |
| 1888 | 697,082 |
| 1889 | 697,949 |
| 1890 | 695,206 |
| 1891 | 634,907 |

*Sand and Gravel.*—No returns were asked for nor received, bearing upon the production of sand and gravel in Canada; the only statistical data available, therefore, are the following tables of exports:— Sand and Gravel.

STRUCTURAL MATERIALS.

TABLE 21.

EXPORTS OF SAND AND GRAVEL.

| Province. | 1890. | | 1891. | |
|---|---|---|---|---|
| | Tons. | Value. | Tons. | Value. |
| Ontario | 341,656 | $64,398 | 243,294 | $58,283 |
| Nova Scotia | 170 | 750 | 230 | 805 |
| New Brunswick | 210 | 290 | 200 | 400 |
| Manitoba | 122 | 80 | | |
| British Columbia | | | | 13 |
| Totals | 342,158 | $65,518 | 243,724 | $59,501 |

STRUCTURAL MATERIALS.
Sand and Gravel.

## STRUCTURAL MATERIALS.

### TABLE 22.

### EXPORTS OF SAND AND GRAVEL.

| Year. | Tons. | Value. | Year. | Tons. | Value. |
|---|---|---|---|---|---|
| 1877............ | 11,998 | $ 2,151 | 1885............ | 110,661 | $ 22,878 |
| 1878........ .... | 50,140 | 8,381 | 1886........... | 124,865 | 24,226 |
| 1879. .... . . | 46,999 | 9,438 | 1887... ......... | 180,860 | 30,307 |
| 1880...... ...... | 53,951 | 11,177 | 1888..... ....... | 260,929 | 38,398 |
| 1881.... . .... | 58,693 | 15,129 | 1889............ | 283,044 | 52,647 |
| 1882. .......... | 60.158 | 16,218 | 1890... ... ... | 342,158 | 65,518 |
| 1883............ | 55,346 | 14,065 | 1891............ | 243,724 | 59,501 |
| 1884........... | 73,741 | 19,978 | | | |

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(NEW SERIES.)

## ABBREVIATIONS.

| | |
|---|---|
| Al. | District of Alberta. |
| Ath. | District of Athabasca. |
| B.C. | British Columbia. |
| Ma. | Province of Manitoba. |
| N.B. | New Brunswick. |
| N.S. | Nova Scotia. |
| N.W.T. | North-west Territory. |
| O. | Province of Ontario. |
| Q. | Province of Quebec. |
| Sk. | District of Saskatchewan. |

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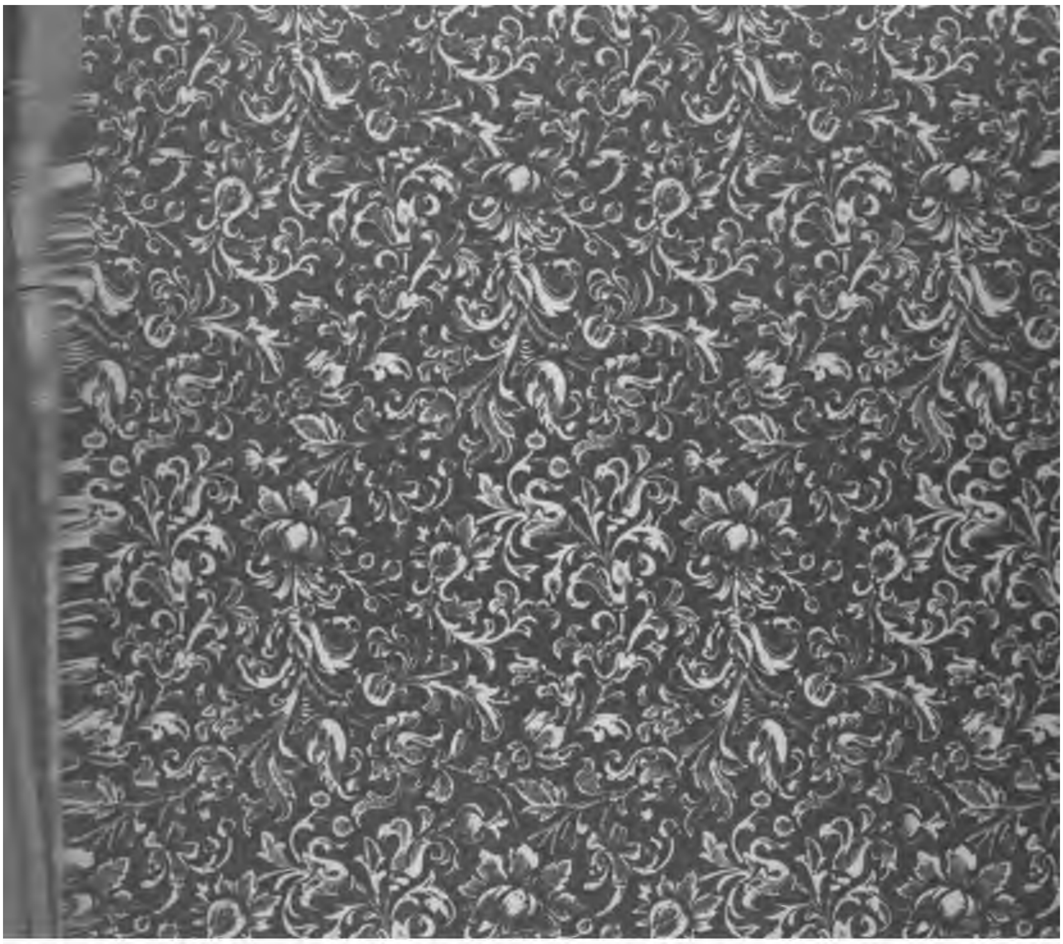

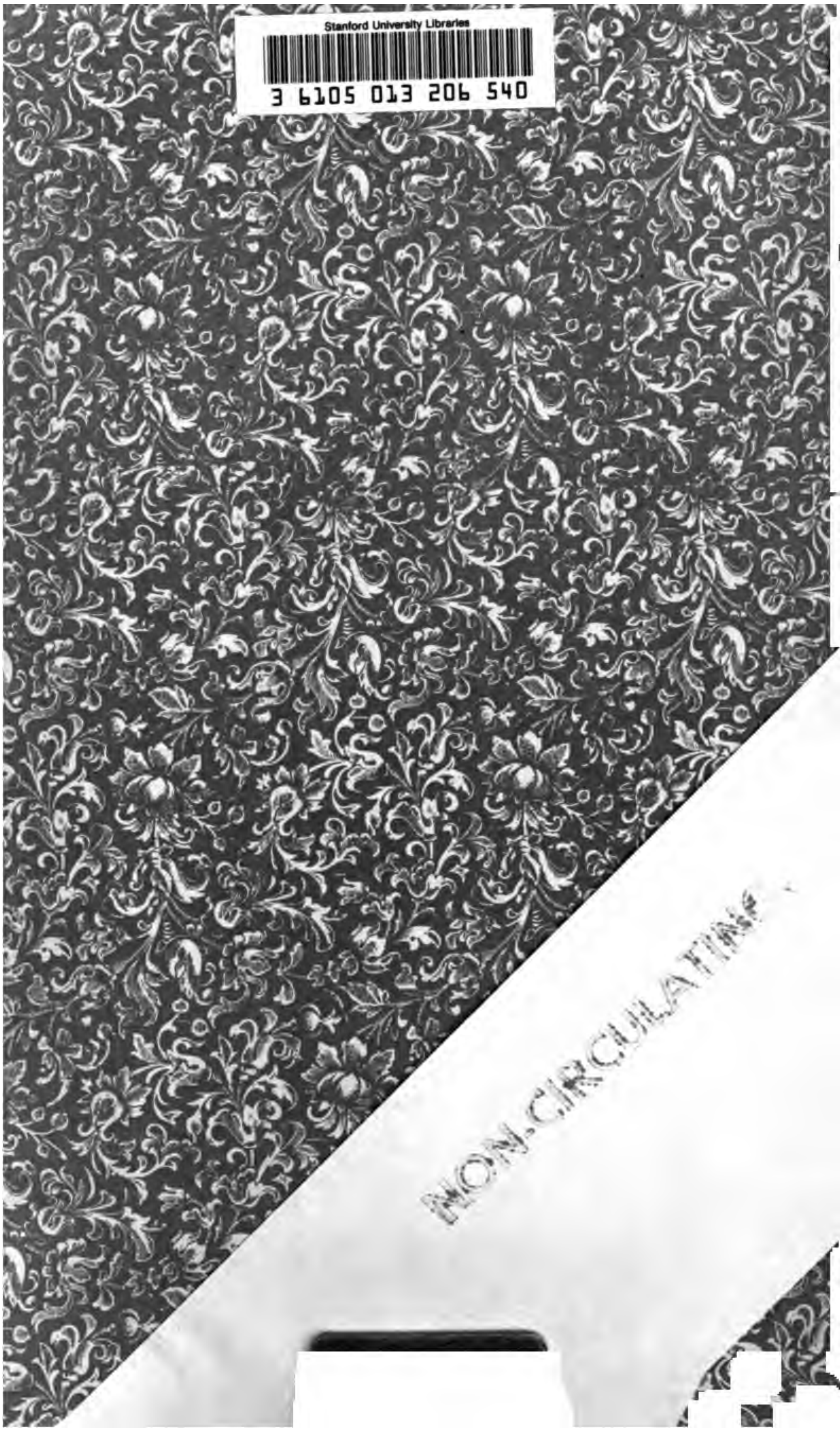

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